PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited.

41 PARK ROW (TIMES BUILDING), NEW YORK

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.

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1881 contained		28	different adv'ts.	1889	"	234	" "
1882	"	45	" "	1890	"	289	" "
1883	"	63	" "	1891	"	325	" "
1884	"	82	" "	1892	"	316	" "
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VOL. XXII. NEW YORK, JULY 15, 1893. NO. 3

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Our Patent Record. OWING to delays in the Patent Office we are unable to publish our Patent Record as usual this week. When the delayed matter is received it will be published in the next issue so that there may be no discontinuity in the record.

The "Deadly" Cable WHEN the daily press of New York was bitterly opposing the "deadly trolley," we called attention to the fact that the cable car, owing to less surety of control, was more menacing to human life than the trolley car, and recent events have justified the statement, although, almost miraculously, there has yet been no loss of life. While with greater practice the gripman will doubtless become more efficient, yet the accident of last week, to which we refer elsewhere, and several others, have not been due to personal causes, but to greater liability of accident, as compared with trolley cars, from less certainty of control of the grip and derangements to which the grip mechanism is subject. Thus far the accidents have served as excellent object lessons to those fearful of the trolley, and as there has been, fortunately, no loss of life, they have accomplished a public good by thus indirectly demonstrating the superiority of control of electric cars.

New Welding Process. IN several recent issues we gave accounts of a new process for electrical welding and in another column print an interesting account, by Mr. Neher, of experiments with the same. It will be noted that it only took 15 seconds to heat a three-eighths inch iron rod to 2,000 degrees C., and that the temperature of the electrolyte was not appreciably raised—only 3 degrees C. The efficiency of the process was calculated to be 35 per cent. in a particular case, and while this is not as high as has been claimed, yet it is still a very satisfactory figure. The explanation of the heating effect is somewhat different from that heretofore given, being ascribed primarily to arcs through the hydrogen envelope. A critical voltage was found by the experimenter, and he refers to the advantage of this method of heating out of contact with the atmosphere. Altogether, the new process seems to be a promising one, although it is not yet certain that the temperature can be so exactly controlled as has been claimed.

Candle Power of Arc Lights. SOME time ago we referred editorially to a petition from a responsible source to the chairman of the committee of the World's Fair Electrical Congress, suggesting that the candle power of arc lamps should be defined in terms of the current and voltage. The necessity of some definite method of settling disputes in regard to the candle power of arcs is a pressing one, and it is difficult to see how this can be accomplished other than through some authoritative body such as the electrical congress that will soon meet in Chicago. Owing to the absence of accepted definition for "nominal" as applied to the rated candle power of arcs, there is no basis at present upon which to settle the many disputes which occur; the most remarkable results may thus be arrived at, as in recent tests at Buffalo where three learned professors reported that the candle power of 2,000 (nominal) arcs they meas ured was about 2,400 c. p. maximum and 2,100 c. p. minimum. While it may not be within the province of the electrical congress to formally commit themselves to any definition of the candle power, which would be difficult to arrive at on a strictly scientific basis, yet an expression of opinion on their part that the commercial candle power of arcs should be defined in terms of the voltage and current would go far toward settling a matter of great practical importance.

Electro-Medical Quacks in England. FOR the past five years *The Electrical Review* of London has on various occasions published articles calling attention to the worthless nature of so-called electrical or electropathic belts, and finally a firm very prominent in this notorious business sent a letter to newsdealers threatening to hold them responsible for libel if they sold any copy of the journal containing "defamatory" articles or paragraphs against their belt. This action was apparently welcomed by our enterprising contemporary, who at once instituted suit, and shortly after was itself haled into court to answer charges of libel, this apparently as a "bluff." The outcome of the matter is that our contemporary was acquitted on the charge of libel and awarded $5,000 damages. In this battle against quackery almost all of the eminent electricians of England enlisted, and Lord Kelvin, Prof. S. P. Thompson and others on the witness stand testified to the charlatanry of the claims, and their testimony, we may remark, applies equally well to the numerous other devices of the same kind that are on the market, not only in England, but in America. A few years ago a firm in the United States unblushingly advertised and sold "liquid electricity," warranted as a universal panacea, and are probably still doing so, and the recollection of the medical "fake" exhibit expelled from the World's Fair is yet fresh. While our English contemporary deserves great credit for unselfishly fighting the battle which should have been undertaken by the medical press, yet it is doubtful if persons senseless enough to be swindled by electro-medical nostrums are worth fighting for.

The Economy of Street Railways. IT is singular that in matters electrical so little weight should be attached to important points that in any other kinds of work would, as a matter of course, be carefully considered and treated in a common-sense and businesslike manner. The strangeness of many of the applications of electricity may, perhaps, in the mind of the ordinary electrical investor prevent him from viewing them in the same light that he does other affairs in which he has invested, and thus permit him to be easily led into error by interested advice; or, perhaps, blinded by the popular idea in regard to electricity, he may think that the new agent does not require that careful attention requisite otherwise to obtain successful results, but will "get there" all the same. In some recent articles Lieut. Cahoon called attention to some of the bad results from this misconception that have occurred in electric lighting, and in the present issue he takes up electric street railways, and shows that the same hap-hazard methods are often met with in their management. With the advance in knowledge that will come from the more general familiarity with electricity, many of the absurdities now indulged in will of course become evident to all, and therefore cease to be practiced, but there will remain many real difficulties in the way of attaining high economy that can only be successfully met by those possessing technical skill. In other words, at the present day particularly, and at all times if high economy from any electrical plant is desired, the services of skilled men are a necessity, and the proper skill is only possessed by those having a thorough knowledge of the apparatus and other details concerned. This advice in any other calling would be trite indeed, but it is far from being so as applied to electrical engineering.

Chilled Enthusiasm. A DUBLIN paper last week explained why there was not more cheering for the royal bride and bridegroom by saying that the hot weather in London chilled the enthusiasm. Our Chicago contemporary, the *Western Electrician*, wonders why so much credit was given to THE ELECTRICAL WORLD for its report of the Columbia lamp case at St. Louis, when so little was said about the fact that it, the *Western Electrician*, actually published the opinion of Judge Hallet before it appeared even in THE ELECTRICAL WORLD. Our esteemed Windy City contemporary, unfortunately for it, printed two or three typographical errors in the opinion, and the St. Louis evening paper of the day before, which had printed the opinion in full, by some strange and unhappy coincident had contained precisely the same typographical errors. Should it happen that the decision in the Milwaukee case, of which THE ELECTRICAL WORLD publishes a report in this issue—made on the spot by the same editor who wrote up the Boston case and also the St. Louis case—may be rendered in time to enable our enterprising contemporary to publish it also a day ahead of the Eastern journals, it is to be hoped that it will look for typographical errors in the daily paper from which it may copy it. When THE ELECTRICAL WORLD sends an editor and an artist to Boston, and again the same editor and the same artist to St. Louis, and later on also to Milwaukee, to report a case, it must consider it of more importance than do its contemporaries, not one of whom sent even an editor, not to mention an artist, either to Boston, St. Louis or Milwaukee. THE ELECTRICAL WORLD does not find that even the hot weather chills the enthusiasm of its readers, for they seem at all seasons to appreciate the efforts it makes to serve them.

The Oconto Case at Milwaukee. ANOTHER remarkable chapter in this most remarkable lamp litigation has now been written, a portion of which is given elsewhere in this issue. The arguments did not close soon enough to permit us to give the whole story this week, but we will continue it in our next. This present trial will go down to history as one of the most thoroughly prepared and closely argued preliminary hearings in the annals of patent litigation. Both sides say that it is rarely that a case for final hearing is so carefully prepared. It has been distinguished on both sides by charges of a serious nature—fraud and perjury being directly charged and crookedness and dishonorable conduct of the principal actors in the drama being freely imputed. The case has differed materially from either of those that preceded it, in that questions which before were kept in the background are now for the first time brought into prominence. Henry Goebel, Jr., who heretofore has been the mainstay of the defense, together with several others, now appears in behalf of the complainants, claiming that he himself made the lamps 1, 2 and 3. Korwan comes forward and says that he made the tool No. 6, and other witnesses, whose testimony had heretofore been on the side of Goebel, come out with admissions which, if true, upset the whole story. On the other hand, as will be seen in the next issue, the defense charge that these witnesses have been bribed by the complainants. They show even a stronger chain of evidence to establish the truth of the original evidence than has been presented before, and much of this evidence is new and pertinent. It had been claimed by the complainants that if they could only get the witnesses for the defense on the stand, they would break down their testimony. On their motion some of these witnesses have been put on the stand and subjected to cross-examination, although that latitude which complainants desired was denied them. They, however, utterly failed to seriously weaken their evidence. Although the order of Judge Seaman permitting the complainants to put the witnesses for the defense on the stand, where they were examined in rebuttal of their own new evidence was unusual and regarded as most unfavorable to the defense, it has not resulted in their discomfiture, but rather to their advantage. The most important new witness for the defense is Wm. A. Goebel, of California, who in a deposition covering 100 pages of the record substantiates much of the earlier testimony and brings out considerable that is of the utmost importance. The case was brought to a close on Saturday July 8, and now only awaits the decision of Judge Seamen.

The True Seat of the Electromotive Force of the "Voltaic Sell."

BY W. J. HAMMER.

It is really quite refreshing to note Mr. Benjamin's candid admission that he possessed such meagre knowledge when he wrote his little book, seven years ago, that he was forced to rely mainly upon second-hand authorities. Still, if he keeps on improving in both knowledge and modesty, who knows what we may be led to expect of him seven years hence? He will, I trust, however, take it in good part when I suggest to him that even he has not yet attained the sum of all knowledge electrically, and, to my mind, it is somewhat risky for him to so exert himself in endeavoring to dispose of his library, which is now on the market. Perhaps, though, he seeks to dispose of only the second-hand authorities, and thus magnanimously help such students as the writer, who are pleased even to embrace such an opportunity of learning something of this "Age of Electricity" which, I believe, Mr. Benjamin has copyrighted.

I think the "true seat of electromotive force" in this particular "sell" which Mr. Benjamin says he "has been trying hard for several years, without success, to get his publishers to 'recharge,'" is that publishers, as a rule, are endowed with such perspicacity that purely business instincts and financial results outweigh sentimental considerations. Let us hope Mr. Benjamin's latest effort, which he has so well compiled from various "second hand" and first-class authorities, may turn out more successful.

If Mr. Benjamin attended occasionally the meetings of the American Institute of Electrical Engineers he would know that, of the dozens of designs presented by several committees during several years past, the one finally adopted unanimously by the Council and by the Institute was before the members for several months, during which the committee asked for criticisms and suggestions, and even had printed descriptions of the badge circulated at the meetings, and the design and description placed upon a blackboard and recorded in the Proceedings. The design met with unanimous approval and adoption officially by the Institute, and the secretary informs me that, although three separate orders have been placed for the badge, he has been unable to keep up with the demand for them. The committee, of which I had the honor of being a member, was instructed by the Council to secure designs for an official badge and an official certificate. Many were presented, and, after lengthy discussion, the Council applied the law of the "survival of the fittest," and their judgment received the indorsement of the Institute, and the secretary was instructed to place a cut of the badge upon all the official documents, stationery and publications of the Institute.

That my work upon this committee should call forth from Mr. Benjamin an indulgence in personalities does not in the least worry me, for I sincerely feel that I can stand his appellation of the "Only Electrical Barnum" with fully as much equanimity as Mr. Benjamin does his well-won title of "Self-Appointed Public Censor."

How Did It Get the Photograph?

Some little time ago The Electrical World mentioned the fact that the "Western Electrician" had published a cut of the Tower of Light in the Electricity Building at the World's Fair a week ahead of its Eastern contemporaries, and only two months later than the one on the same subject published by The Electrical World, which had been made from the architect's drawings before the tower had been put up.

We hoped at the time that the "Western Electrician" would settle the matter of this prior publication with its own conscience.

Referring to the subject the "Western Electrician," in a recent issue, says:

"We are happy to be able to assure The Electrical World that our conscience is easy on that score."

It was understood that the photograph used for the illustration published by the "Western Electrician" was made for and paid for by the General Electric Company, and that the other electrical journals were asked not to photograph or make sketches of the tower in advance of official permission, and promised that if they would be real good and obedient and not undertake to illustrate or describe the tower, except with the full approval and consent of, and at the time decided upon by, those in authority, each of them would be furnished with a copy of the official photograph precisely at the same time.

The Electrical World had illustrated the tower two months before in a manner, some say, preferable to anything that has been done in that direction since, and was not, therefore, as it happened, so much interested in the photograph as were some of its contemporaries who have to depend upon photographs for illustrations.

However, neither The Electrical World nor any of the other Eastern journals, so far as we know, received the photograph until a considerable time—something like two days—after a copy had been furnished the "Western Electrician."

In fact, some of the papers did not get the photograph until after the "Western Electrician" containing it had been distributed at the World's Fair grounds.

An explanation in regard to the matter would seem to be in order from somebody.

The official representative of the General Electric Company had pledged his word that the papers should be treated alike. It may be, however, that not he, but the official photographer of the World's Columbian Exposition, was to blame. If so, or wherever the blame, the matter ought to be investigated, with a view, if possible, of preventing anything of this kind happening again.

When a journal is enterprising and sends its own artist at considerable expense to make a sketch in advance of its contemporaries, that is one thing; when, however, without going to any expense, it arranges to have its copy of a photograph made for all the papers in common delivered to it sufficiently ahead of the others to enable it to use it a week in advance of the others, that is quite a different matter. Under such circumstances, moreover, it hardly seems in good taste for the "Western Electrician" to try to boast too much over its "achievement."

We Omitted the Carpenters' Plans.

A Western contemporary thinks that The Electrical World, in "transporting an important portion of its staff to the rush and whirl of Chicago life has become somewhat confused" in its mental vision. As an illustration of such confusion it refers to the sketch of the luminous tower in the Electricity Building published by The Electrical World two months ago, and says that while "it is not difficult to detect a resemblance" between the sketch and "the tower as actually built," it points out several minor differences. The "Western Electrician" is correct. There probably has been a slight confusion of mental vision in regard to the Tower of Light, but that has been caused by the dazzling brilliancy of the noble prismatic lamp which surmounts the graceful pile. The Electrical World's drawing, however, was not a representation of the complete structure, for we deliberately and intentionally omitted to publish the carpenter's plans, just as we did in the case of our fountain article. There is but one journal in the world that has covered this part of the structure completely, and that is our telegraphic contemporary (teleos, at a distance, and grapho, I write), and to it we would give full meed of praise for its enterprise and discrimination. The fact is, that our sketch was made from the architect's plans, which have undergone some changes since then, but at the time there was said to be some dispute between Messrs. Stieringer and Spencer about the joiner work—one maintaining that the stays should be dovetailed into the stringers and struts, while the other insisted that they should be nailed together. Pending the settlement of this interesting dispute, we deemed it wise to omit these details altogether. We promise to turn the tables on our contemporary later, however, and don't mind telling just how we will do it either. Some time in next autumn, when the two band stands are finished—those stands from which sweet music is dispensed on the Grand Plaza—we propose to publish in full the structural features of both stands, provided, of course, we can do so with the full approval and consent of those in authority—that is, if our telegraphic contemporary (teleos, at a distance, and grapho, I write) does not take advantage of this announcement and "scoop" The Electrical World for once in its life. It is information of this character that proves interesting to the readers of an electrical journal.

The Niagara Turbines.

Two of the ten 5,000-h. p. turbines for the Niagara Falls plant are being completed by Messrs. Cramp, Philadelphia. The water will flow to the wheels through a vertical penstock 7 feet 6 inches in diameter, which receives the water from a canal 14 feet wide and 12 feet deep, the requirement of flow being about 25,000 cubic feet per minute. The turbine wheels themselves revolve upon the outside of a cast iron case, and are attached to a vertical shaft, which is unique in its construction, being made of successive sections of wrought iron tubes of several feet in diameter, joined by steel couplings and intermediate solid shafts 11 to 12 inches in diameter, wherever supports are required, to steady the vertical revolving column. The velocity of this revolving mass is 250 revolutions a minute, the wheels themselves being 6 feet in diameter.

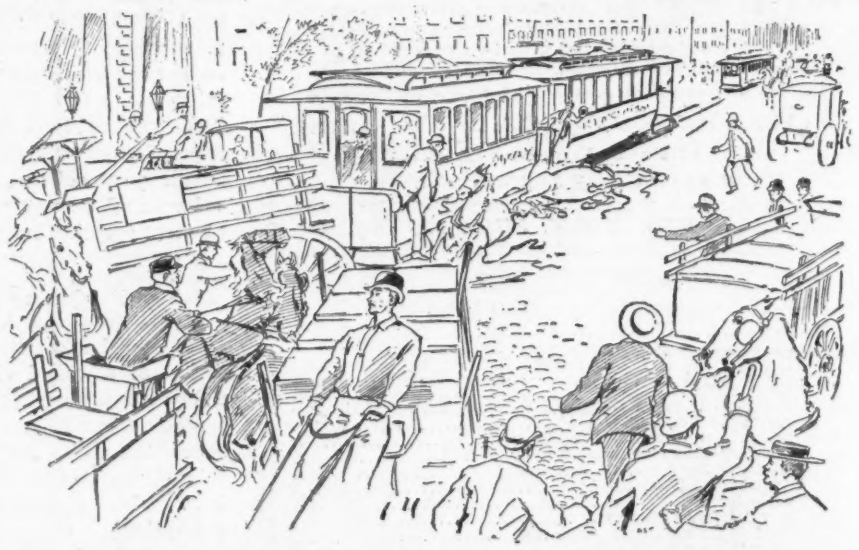
The speed of the wheels is governed by ring gates outside of the wheels, which are of magnesium bronze of the same composition as the best propeller blades for the United States Navy. Each of the two wheels is divided into three sections, constituting six distinct wheels, three of each being in one casting. In the regulation the movable gate affects only one of these sections at a time, so as not to interfere with the free discharge from the remaining sections. The governing machinery is being built in Switzerland, and is of peculiar construction, guaranteed to effect a closer regulation of speed than has been attempted heretofore in such revolving masses.

These water wheels are intended to drive electric generators or dynamos, which are placed on the ground 150 feet above the wheels, the revolving part of which will be supported entirely upon a water bearing in the wheel case below, so that the revolving part of the dynamo will be revolving upon and with a vertical shaft, just as a top would spin, upon the water below.

Some slight idea may be formed of the immensity of this piece of machinery in totality when it is considered that the space occupied by the machinery is fully 30 feet by 16 feet square in a rock chamber about 175 feet in depth.

The Deadly Cable Car.

It is stated that Mr. A. B. Widener, who is largely interested in the Broadway cable road of New York City, enthusiastically announced some time ago that the cable system of traction was destined to "sweep everything before it." If that gentleman could have stood on lower Broadway in the afternoon of July 6 he would have undoubtedly been convinced of the truthfulness of his prophecy. Cable car No. 77, while on its downtown trip in the neighborhood of Chambers street, got its grip entangled with the cable so securely that when the gripman endeavored to let go in order to take on a passenger he found that he had entirely lost control of the car. The car proceeded down Broadway, which at this time of day is crowded with trucks, horsecars and foot passengers, at full speed. When near Vesey street the car overtook a truck drawn by a pair of mules, with the result that the wagon, driver and mules all landed in a heap at the side of the track. A short distance farther on horsecar No. 239 was overtaken and pushed ahead for a short distance; one of the horses managed to get loose, but the other laid down on the track and was shoved along until it finally rolled off at the side. Cable car No. 59 was soon overtaken, and, with several wagons added, the procession proceeded on its course. At Cedar street the column overtook horsecar No. 309. One of the cable gripmen ran ahead and cut the traces of these horses, so that one of them escaped without injury, the other being pulled along for a short distance. In the meantime one of the inspectors of the road had secured telephone communication with the power house, and by the time the procession had reached Rector street the cable had been brought to a standstill. Fortunately the car carried but few passengers, and these were rescued without any serious injury; that such proved to be the case is certainly remarkable, and the probabilities in case of a repetition of such an accident are that serious damage to life and property would be the result. The accompanying illustration, for which we are indebted to the New York "Herald," gives a view of the scene of the accident at one of its most interesting points.



A VIEW OF THE RECENT CABLE ACCIDENT IN NEW YORK CITY.

Even the daily press, which had so much to say about the "deadly trolley," seems to appreciate the dangers of cable traction.

"After one day's interval," say the New York "Tribune," "the Broadway cable set out again yesterday to make another bad record. It succeeded. The trouble this time was with a grip that gripped so firmly that it could not be released. The result was that a car proceeded downtown sweeping all before it for a distance of half a mile." In another of the well known metropolitan dailies the following headlines were seen: "Cable Car Runs Wild in Broadway," "Rammed Four Other Cars, Tossed Trucks Aside and Dragged Horses Along," "Passengers Jump to Safety," "Caused by a Slack Cable," "Another Accident Earlier in the Day Due to the Neglect of a Green Motorman."

Electricity at the World's Fair.

EXHIBIT OF QUEEN & CO.

Thus far in our World's Fair letters we have confined ourselves almost entirely to the more popular side of the science. There is, however, another side of vastly more importance, for it is upon this that the science itself is built. It is what may be termed the scientific side of the science, and involves the instruments of precision by which phenomena and effects are measured, and through the operation of which we are able to give them a concrete existence. To the investigator and the real worker in electricity there is no branch of more vital interest and importance than the construction of the instruments which are used in determining the measure of the results hoped for or obtained. This class will, therefore, find much of interest in this issue, in which we devote considerable space to a description of some of the new instruments which are put on the market by the well known firm of Queen & Co., of Philadelphia. In subsequent issues we will continue this subject, with further descriptions of other instruments made by other manufacturers for the same and other purposes, so that the student may have in this series of articles not only a handbook to the spectacular and more popular side of the electrical exhibit, but also of that more important, though less obtrusive side, the purely technical or scientific.

Hitherto Queen & Co. have been agents for European firms in England, Germany and France, and it is only within the last two or three years that they have manufactured instruments on a large scale, and now they sell practically only instruments made by themselves in Philadelphia. Many of the instruments exhibited are quite new in design, and are now for the first time shown to the public.

Among the foreign firms which Queen & Co. represent are Carl Reichert, of Vienna, and James White, of Glasgow, who makes all of Lord Kelvin's instruments, and the Societe Geneveoise.

In taking up the individual instruments contained in this exhibit, it will not be possible to give them the full and detailed description which they deserve. We will be obliged to content ourselves with a brief account of those pieces which seem to us of most importance, trusting that the illustrations will, to a great extent, supply the lack of data necessitated by want of space.

Perhaps the most important exhibit, and that which contains more new features than any of the others, consists of the galvanometers. Of the Thomson type there are four different patterns. All of these are very high grade instruments, the most noticeable feature being the ease with which coils may be interchanged. Two of them have the terminals of all the coils brought out to a switchboard on the base of the instrument, so that any combination of coils can be effected by a simple change of plugs, thus avoiding the tiresome process of undoing screws and making wire connections. The ballistic galvanometer shown in Fig. 1 contains some striking features. It is incased in a metallic case, containing a window to allow the reflected rays from the mirror to pass through. The coil frames are mounted on corrugated rubber pillars, which offer a high insulation surface, and may be swung back on hinges so that the suspension is quite accessible. The magnetic system involves an entirely new principle, and completely avoids magnetic drift, which has hitherto caused so much difficulty and annoyance to users of galvanometers. Briefly stated, this is accomplished in the following manner: The system consists of two pairs of magnets, constituting two systems, so arranged that the whole system may be made astatic to any desired degree, this being accomplished by short circuiting more or less of the lines of force of the lower magnet by means of a soft iron ring threaded on it. Now, whenever it is desired to alter the sensibility of the galvanometer, it is only necessary to alter the position of the soft iron ring. In this way the sensibility is varied

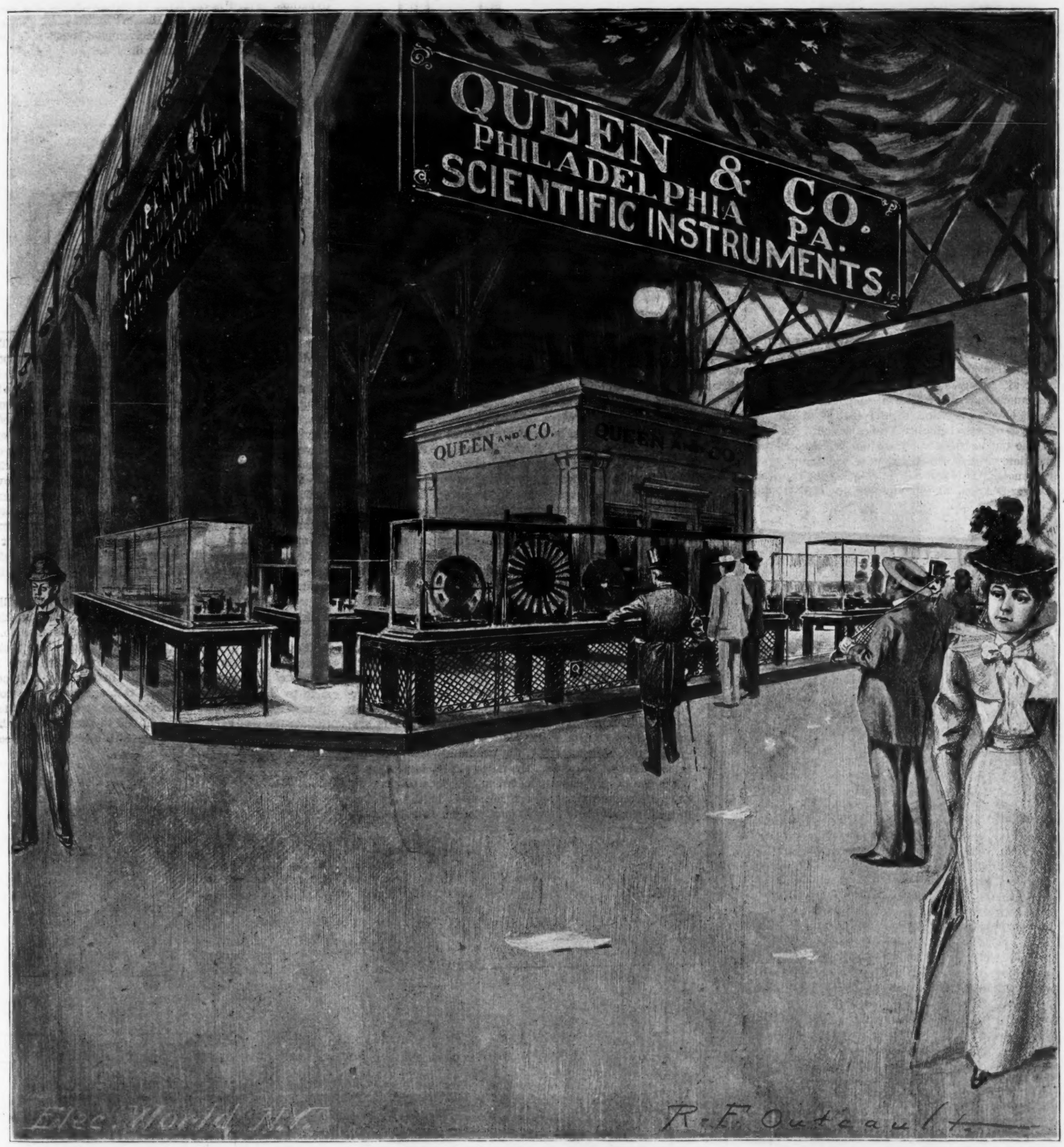
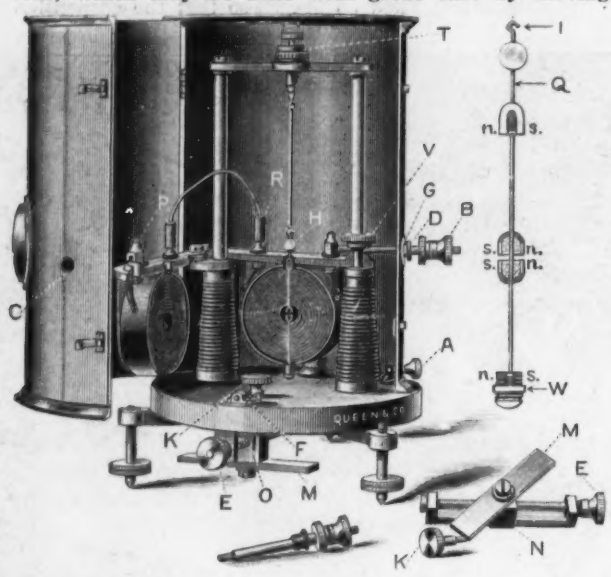
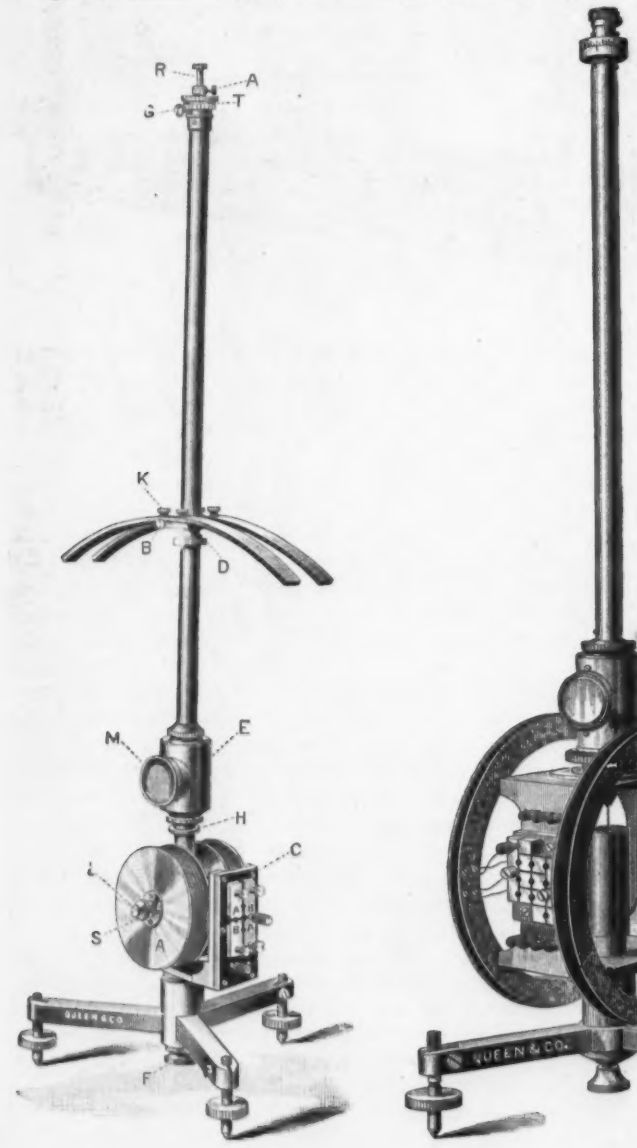


EXHIBIT OF QUEEN & CO. AT THE WORLD'S FAIR.

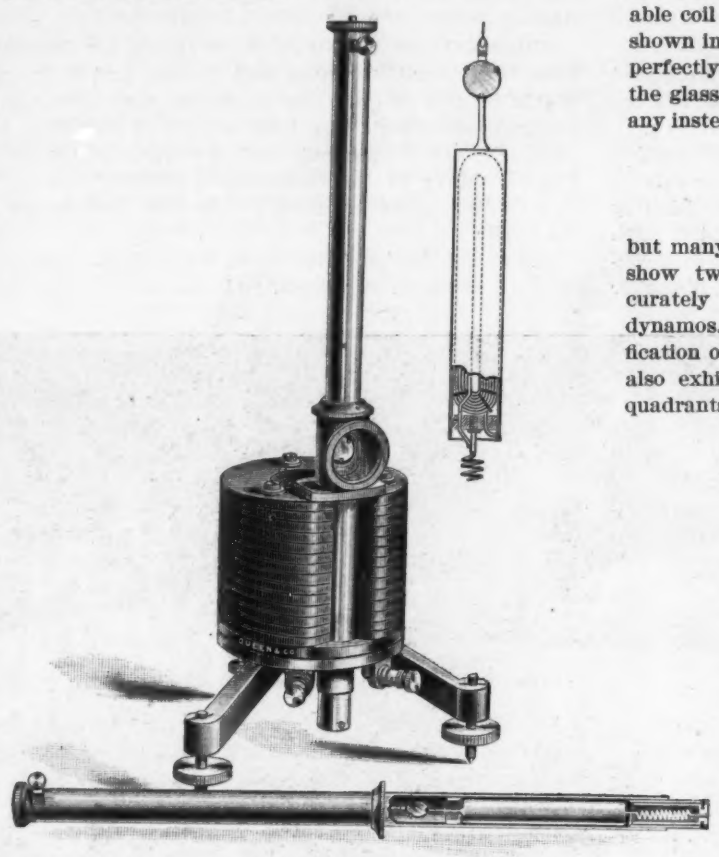
without introducing another force such as that of a control magnet, and thus the only drift incurred is that due to declination of the earth's field, none being caused by variation in its intensity. The dead beat reflecting galvanometer, shown in Fig. 2, is a modification of the Wiedemann galvanometer. Its suspension is 2 feet long, and consists, like those of all the high grade instruments made by Queen & Co., of an exceedingly delicate quartz fibre. This instrument is very convenient. Automatic contact is made between the terminals of the coils and a small switchboard, and its sensitiveness may be varied by different connections of the coils, by changing the coils, which may be done with great ease by moving

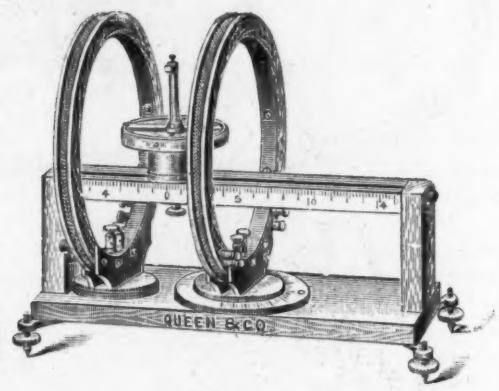


them away from the magnet, or by means of the control magnets shown at B. The magnet is of the Siemens bell type, and is surrounded by a massive copper block, which very effectively damps the oscillations. In all of these galvanometers the coils are graded for maximum magnetic effect according to the theory of Maxwell, five changes of wire being used on each coil. The advantages of the quartz suspension are too well known to require mention. Fig. 3 shows an entirely different type of galvanometer. It is Queen's modification of the well known Deprez-D'Arsonval type, and is intended to supply the



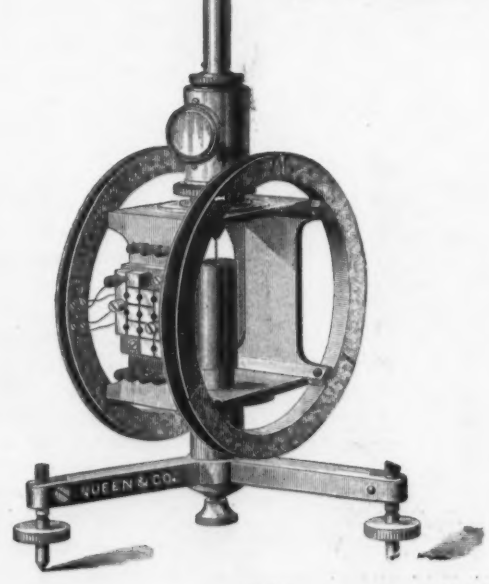
demand for a sensitive deadbeat galvanometer, uninfluenced by intense and varying magnetic fields. It consists of a number of circular horizontal magnets, between the poles of which swings a long narrow coil having a circular cross section. The coil is inclosed by an aluminium tube, which forms part of the movable system, and gives it an absolutely aperiodic movement. In order to change the sensibility of this instrument it is only necessary to remove the tube, and put another with different coil in its place, the contacts being made automatically. In this way any desired sensibility up to a certain limit may be obtained, or the galvanometer may be made ballistic, in which case a high resistance tube, having no aluminium cylinder, is used.

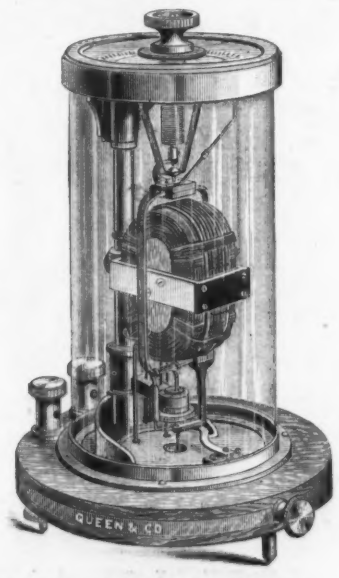


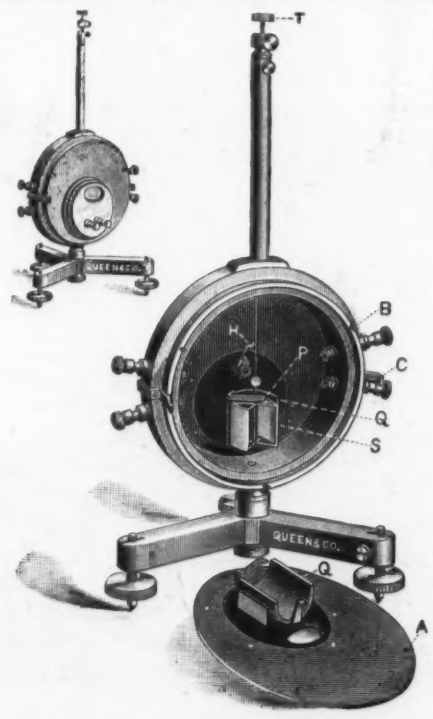


FIGS. 1, 3 AND 5.—EXHIBIT OF QUEEN & CO

Several new forms of tangent galvanometers embodying some new and very useful principles are exhibited. Fig. 4 shows the Anthony Tangent. This instrument is of the Helmholtz-Gaugain type, having two coils placed a distance apart equal to their mean radius. Each coil is wound with two wires of fifty turns. The wires are wound side by side, but are reversed at each layer. To the switchboard in the front are brought the terminals of the coils, so that by means of plugs any desired combination may be effected. The magnet is of the Siemens bell pattern, and is suspended by a quartz fibre. Another new form of tangent is the Moler Swinging Arm galvanometer. It is an ingenious combination of a tangent and cosine galvanometer, giving an enormous range. The coils, two in number, are mounted on an arm in such a way that they may be swung back so as to make the magnetic effect on the medle as small as wished, and thus by using the fine wire coil or the coarse wire loop near or away from the magnet the sensibility may be varied within very wide limits. For students' use the galvanometer shown in Fig. 5 has been found to be a very useful instrument. It is made of two mahogany rings, each having three separate windings. In the groove are two windings of 48 turns each, and on the inside circumference of the ring is a single turn of heavy copper strip 3-32 × ¾ inch for heavy currents. The needle is suspended by a 9-inch fibre. The suspension slides in a groove in a horizontal bar, the needle always remaining in the axis of the coils. By using this device we may place the needle midway between the coils (Helmholtz-Gaugain) in the plane of centre coil as in the ordinary tangent galvanometer, or we may place both coils on one







FIGS. 2, 4, 6 AND 7.—EXHIBIT OF QUEEN & CO.

side of the needle (Wiedemann). The range of this instrument is from .0001 to 30 amperes. Other galvanometers for students' use are exhibited, some very convenient forms, but containing no strikingly new features.

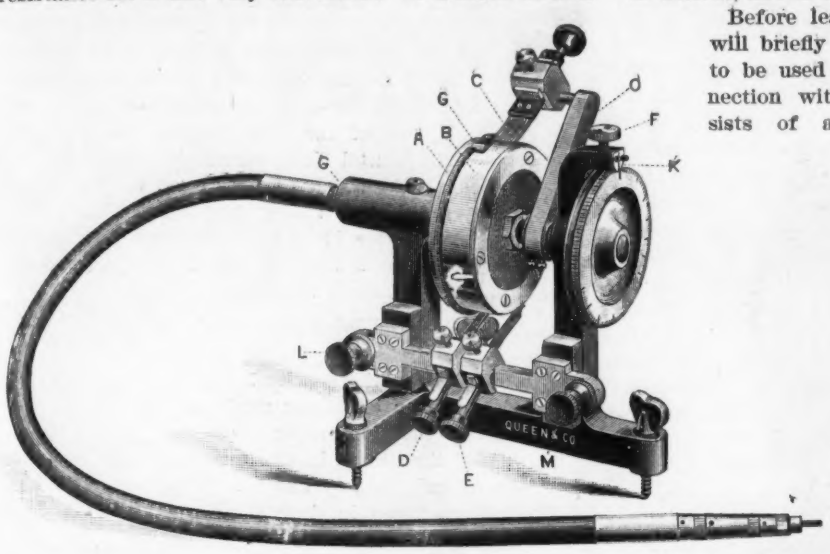
Instruments for measuring alternating currents and potentials are very well represented. The Siemens dynamometer has undergone considerable improvement at the hands of Queen & Co.'s engineers. Fig. 6 shows a type of the instrument known as the closed form. In this instrument only one support is used instead of two, as in the old pattern, thus making it lighter and the system more accessible. A steel pivot has been substituted for the fibre, and an aluminium pointer for the brass one. The screw shown in the front of the base lifts the movable coil from the pivot, and clamps it against the beam shown in the top of the case, thus making the instrument perfectly safe during transportation. In the open form the glass case is omitted and the support is of mahogany instead of brass. The regular ranges are as follows:

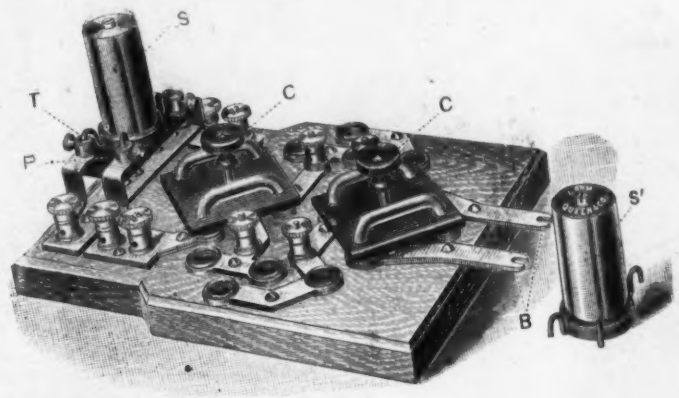
0.2 to 20 amperes,
1.0 to 60 amperes,
5.0 to 200 amperes,
10.0 to 500 amperes,

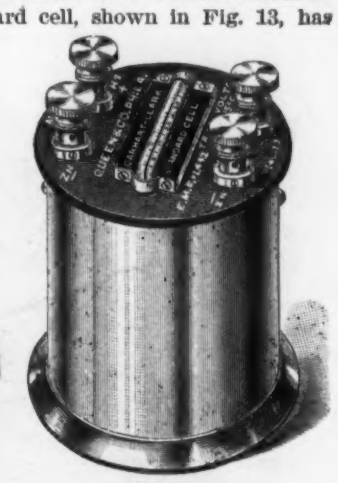
but many especial sizes have been built. Figs. 7 and 8 show two instruments used for determining very accurately the curves of E. M. F. of alternating current dynamos. Fig. 7 is the Ryan electrometer. It is a modification of the well known Mascart instrument, which is also exhibited. The Ryan electrometer consists of four quadrants mounted on quartz discs set on the inside of two metal-covered plates that protect the system. The needle is of aluminium. It is hung by a quartz suspension, and is connected to the outside of the cover case by means of a wire .0002 inch in diameter. In addition the instrument carries on the outside of the cover case two coils of wire so disposed that by means of a current the needle may be deflected. In this way zero method may be employed, the potential difference to be measured being determined by the amount of current necessary to bring the suspension back to zero. The contact maker shown in Fig. 8 is to be used in connection with the last named instrument for constructing the E. M. F. curves of alternators. Its shaft is connected directly to the dynamos by means of a piece of flexible shafting, and contact is made at any one point of the revolution, this point being determined by means of the finely divided scale on the right.

Two of the cases in the exhibit are completely filled with resistances and contain some new and very striking pieces of apparatus. The finest of these is the No. 1 bridge. This bridge contains five rows of resistances, each having two coils in a row, which may be connected in series or in parallel. In this way it is possible to check any one coil in a row against all the coils (placed in multiple) in the next higher row, and thus test the accuracy of each individual coil in the box. Another distinctive feature of this bridge is the temperature coil. This is a device used in measuring the temperature of the box more accurately than by means of a mercurial thermometer, because the latter measures only the temperature in the stratum which contains the bulb. The temperature coil consists of a coil of copper, wound in the same way as the other coils, which has its resistance and temperature coefficient very accurately determined. Now, by measuring at any time the resistance of this coil, which may be done by simply removing the short-circuiting strip shown between the two binding posts at the lower right hand corner of the box, its mean temperature can be obtained from a table. The commutator placed

between the bridge arms is for the purpose of reversing the bridge arms, which is accomplished by simply changing two plugs. The box is of very fine workmanship, and the coils are accurate to 1-50 per cent., and all have the same temperature coefficient. The No. 2 or post-office resistance set is also very convenient. It is much smaller

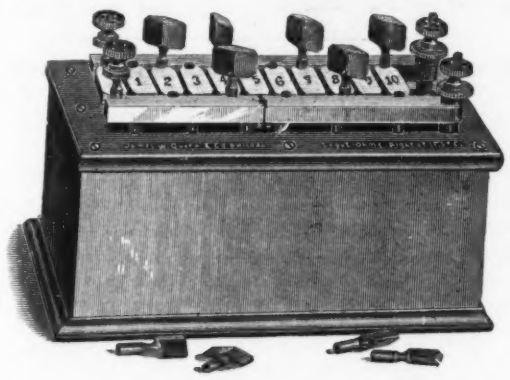


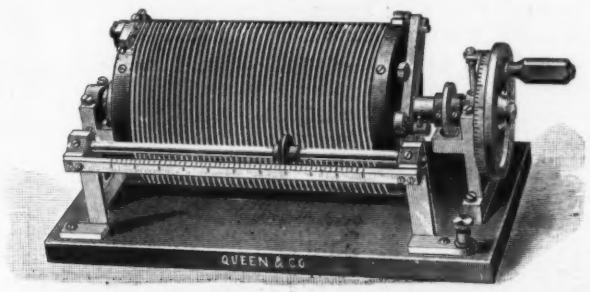


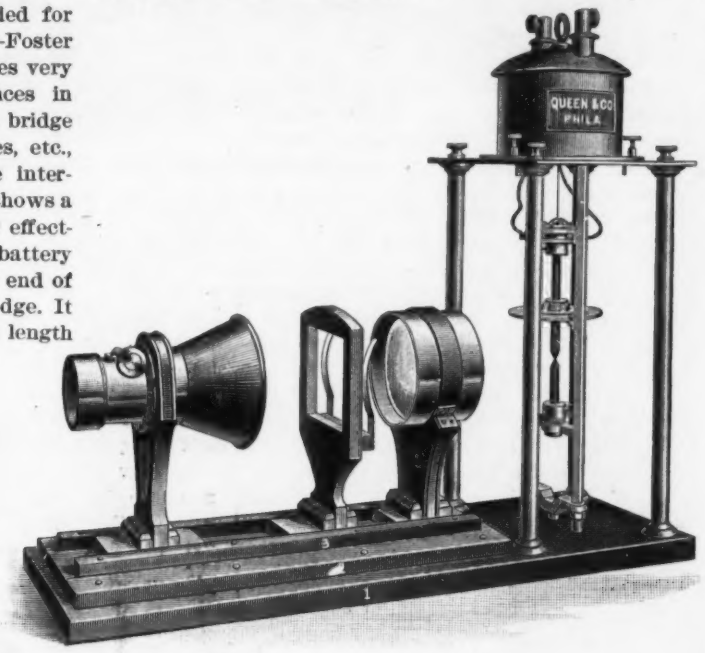


FIGS 8, 11 AND 13.—EXHIBIT OF QUEEN & CO.

than the one just described, and has a thermometer instead of a temperature coil. Fig. 9 shows a new form of 100,000 ohm box, which contains ten 10,000 ohm coils so arranged that they may be put in series or in parallel, enabling one to get not only resistances up to 100,000 ohms in steps of 10,000, but also resistances up to 25,000 ohms in steps of 1,000, this being effected by suitable series or multiple combinations. In addition, the box may be used as a bridge by placing a binding post in the hole shown in the front bar. Other forms of resistance boxes and bridges are displayed, but most of these are standard patterns. In addition to several standard patterns of resistances of the B. A. pattern wound with plantinoid or constantin wire, a new standard is attracting







FIGS. 9, 12 AND 14.—EXHIBIT OF QUEEN & CO.

some attention among electricians. It consists of a circular metallic case containing three coils. First, the standard coil temperature coefficient is very accurately determined wound on a perforated cylinder. Inside of this cylinder are a temperature coil, whose resistance and temperature coefficient are also very accurately determined—this to be used as a thermometer—and a third high resistance uninsulated coil wound on a larger perforated drum, inside of which is the standard. All of the coils dip into an oil bath, which is heated by the outside coil, and whose temperature is measured by the inside coil, the standard being just outside the latter. We thus have the standard resistance thermometer, heater and oil bath in a case about seven inches in diameter.

The carbon rheostat shown in Fig. 10 contains six sets

FIG. 10.—EXHIBIT OF QUEEN & CO.

of carbon pencils, whose terminals are brought out to a switchboard in the front of the box, so that they may be connected in series or in parallel. The resistance is varied by compressing the pencils by means of the hand screws shown on the top. Each section is constructed to carry from 0 to 25 amperes at an E. M. F. not over 5 volts. Using the pencils in multiples, 150 amperes may be used, and this current may be reduced to almost nothing by placing them in series. The instrument is very useful in calibrating instruments with the help of an accumulator battery, as the current may be varied as gradually as desired, not in steps.

Before leaving the subject of resistances we will briefly mention the compensated shunt box to be used with delicate galvanometers in connection with insulative measurements. It consists of a brass box mounted on corrugated ebonite pillars, and contains in addition to the ordinary 1-9, 1-99, 1-999 shunts, coils so arranged that the total resistance of the circuit remains the same when any shunt is used.

We now pass to some new instruments intended for use with the comparison of resistances by the Cary-Foster method. As is well known, this method determines very accurately the difference between two resistances in terms of the length or resistance of a portion of a bridge wire in eliminating the effect of all auxiliary wires, etc., if the two resistances to be compared may be interchanged without altering the lead wires. Fig. 11 shows a commutator designed by Mr. E. G. Willyoung for effecting this interchange, and also for reversing the battery in order to eliminate thermo-electric effects at the end of the bridge wire. Fig. 12 shows a cylindrical bridge. It consists of a wire of uniform gauge five metres in length

wound on a polished ebonite drum. By means of a vernier 1-50000 part of the wire, whose resistance is 1 ohm, may easily be read. The interior of the bridge contains two shunts, and by throwing these in circuit we may read .000002 ohm. A new form of commutator, which is also exhibited, contains a straight bridge wire, and makes the commutation of the coils and battery simultaneously, but it is so arranged that these may be commutated independently of each other. The conductivity bridge, also designed by Mr. Willyoung, is practically the reverse of the Cary-Foster method, inasmuch as the resistance of a

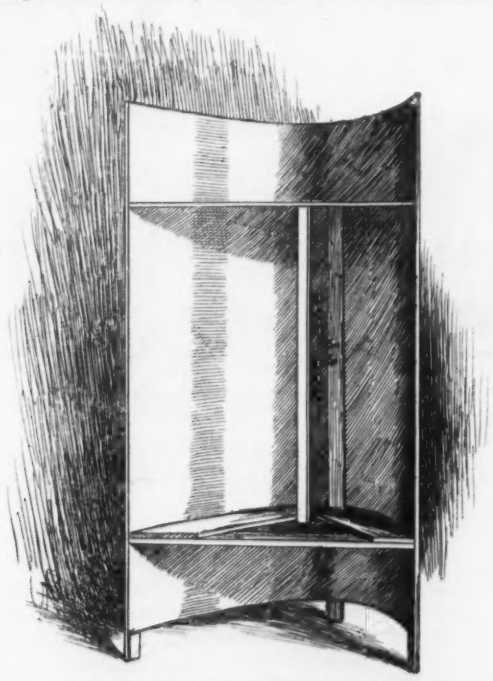


FIG 15.—EXHIBIT OF QUEEN & CO.

portion of the bridge wire (in this case the specimen whose conductivity is to be determined) is balanced against the difference in resistance of two known coils. The smallest portable testing set we have yet seen is the "Acme." It is but 8 inches long by 6 inches wide and 6 inches deep, and contains a bridge, rheostat, battery of 12 aluminium iodine dry cells, and a D'Arsonval galvanometer. It is possible to measure with this instrument from .001 to 11,110,000 ohms. The portable cable testing set is also very compact, and contains all that is necessary for measuring the capacity and insulation resistance of cables, including an astatic reflecting galvanometer, telescope, shunts, condenser and battery of about 60 volts, the whole being set up on a tripod, at the place where the measurement is to be made. The Carhart modification of the Clark standard cell, shown in Fig. 13, has many advantages over the ordinary form; it is portable, has a very small temperature coefficient, and cannot be short-circuited because it has a large resistance in series placed inside the metallic box.

In addition to the instruments already described the exhibit contains a very complete line of student apparatus, consisting of voltmeters, galvanometers, condensers, etc., also a large number of lecture apparatus, including an interesting collection of Crookes, Geissler and spectrum tubes, which are shown in operation in the dark room. The dark room contains also a new arc light projector, shown in Fig. 14. This is the first projector that has yet been successfully operated by means of the electric light, and gives very gratifying results, the arc, which is produced by an alternating current, remaining perfectly steady after it has been adjusted to the optical axis. Photometers of the Bunsen, Rumford and other types are also shown in operation, and a pair of Hertz mirrors, one of the only two pairs in this country, are used for repeating Hertz's experiments. In two of the cases Lord Kelvin's instruments, made by J. White, of Glasgow, for whom Queen & Co. are the sole American agents, are exhibited. These include ampere gauges, statical voltmeters and balances. C. Pein, of Stuttgart, exhibits several very interesting hand dynamos, which operate an experiment table containing, among other things, a polyphase and a direct current motor.

The office contains a handsome switchboard, with the various commercial instruments made by Queen & Co., and including the well known magnetic vane ammeters and voltmeters and the Cardew hot wire voltmeters.

There are five other exhibits of optical, microscopical, physical, chemical and photographic apparatus in the Liberal Arts Building. All of these are in charge of Mr. C. W. Pike, who is assisted by several of the company's engineers.

EXHIBIT OF THE MCINTOSH BATTERY AND OPTICAL COMPANY.

About in the centre of their display, which is immediately across the aisle from the H. W. Johns Manufacturing Company's display, may be found what they have been pleased to call their World's Fair Cabinet, which is a handsome affair in mahogany, with all the latest improved appliances for giving electricity for therapeutical purposes. To the south is a large eight-plate Atkinson-Topler machine, giving an 11-in. spark between its terminals, which is the largest machine of its kind that this company have ever made. Upon a sample

board, which is north of the electrical cabinet, are shown switchboards for adapting the electric lighting current to therapeutical purposes; induction coils, multipoint switches, etc., and a number of handsome oak wall cabinets for electrical therapeutists. There is also shown on this board a small dental engine operated by a ⅛ h. p. electric motor. About the centre of the east side of their space is shown a large bath tub adapted with

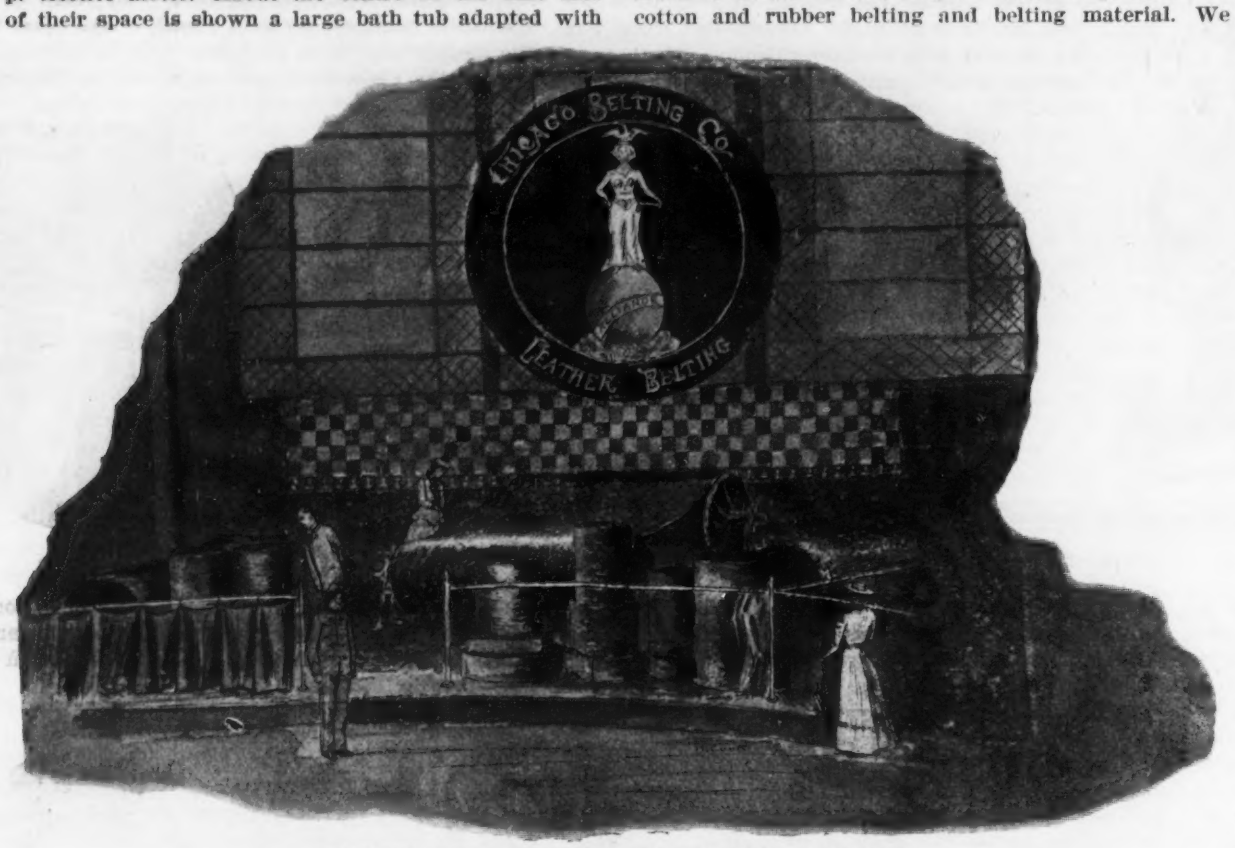


EXHIBIT OF THE CHICAGO BELTING COMPANY.

metallic terminals for electrical purposes, and on either side are very handsome electric therapeutical cabinets, containing all of the instruments and devices used and convenient for electro-medical purposes. In glass cases surrounding the exhibit are a large and complete line of apparatus also adapted to the same purposes. Among these we note electro-cauteries and electric exploring bulbs, and electrodes of various kinds, and also a number of handsome medical batteries of their well known make. In fact, the display makes a most complete exhibit of the apparatus now required in the new science of electrotherapy. While the static machine is here shown in operation in connection with some of the more common applications, this display must not be confounded with what are usually termed electrical fakes, which, we are sorry to say, form such a prominent feature in certain parts of the Electricity Building. There is nothing in this display but what is legitimate, so far as we have observed; nor is there anything that has not received indorsement of that part of the profession which is engaged in advancing the science of electrotherapeutics.

we illustrate. A specialty of this firm is the manufacture of belts specially adapted for the use they are to undergo, and of these a number of dynamo belts are shown which are different for slow and fast running dynamos. The "Reliance" brand is another belt that has established an enviable reputation for itself, and these are here shown in all sizes, as well as specimens of cotton and rubber belting and belting material. We learn that to meet the demand in the far south an agency has been established at New Orleans under the management of Mr. W. R. McKee.

EXHIBIT OF THE S. S. WHITE DENTAL MANUFACTURING COMPANY.

This company make quite an extensive and attractive display of their specialties in the west gallery of Electricity Building. At the rear of their space a large sample board has been erected, upon which their name appears in the centre, with the main place of business, Philadelphia, directly beneath. To the right and left are the locations of their principal agencies, New York, Boston, Brooklyn and Atlanta. In the centre of the middle panel is a large switching set, and on either side, tastefully arranged, are electric bells and dental engines.

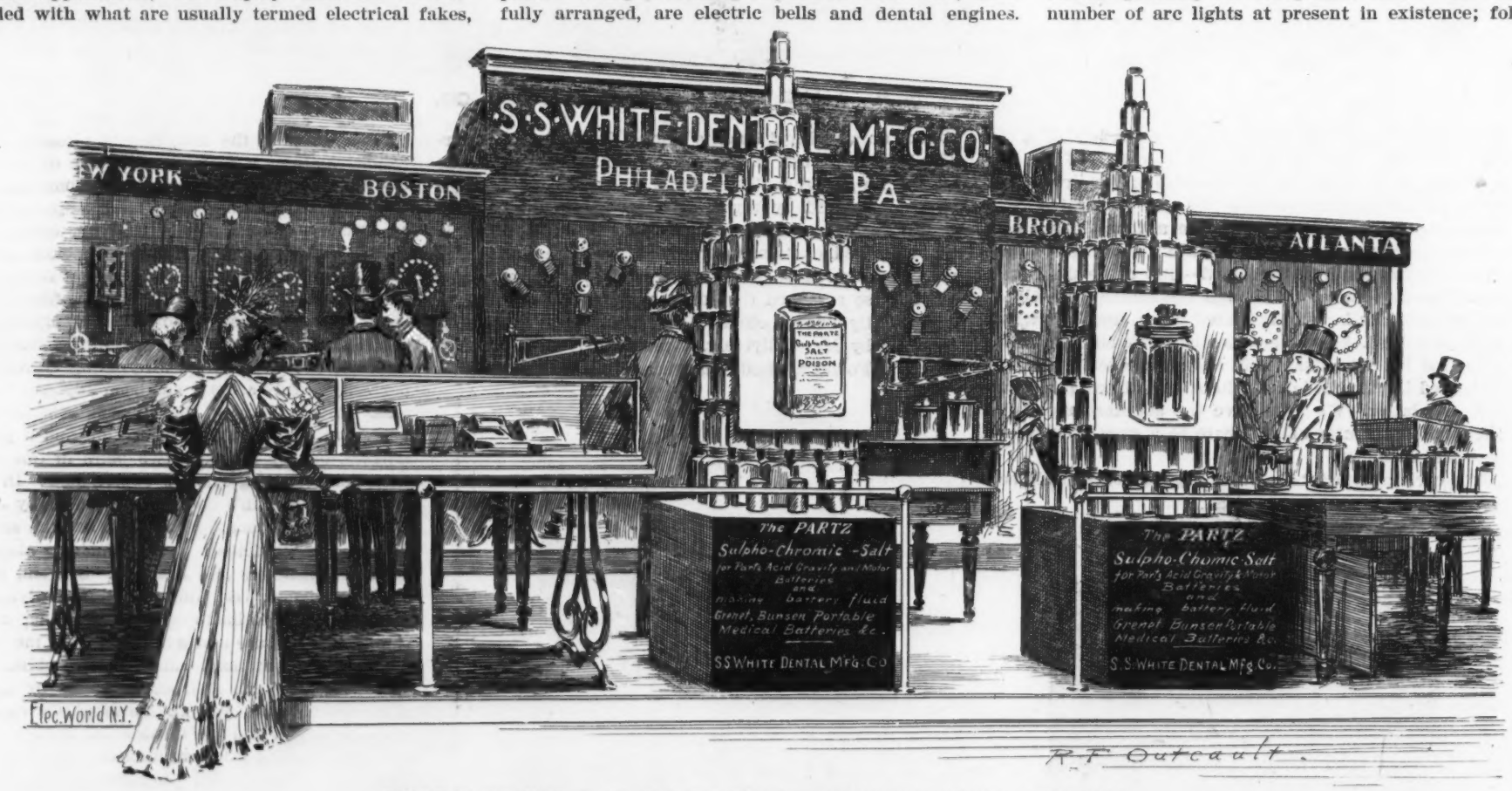


EXHIBIT OF THE S. S. WHITE DENTAL MANUFACTURING COMPANY.

Although a comparatively young concern, the Chicago Belting Company, of 26 West Randolph street, and has made great strides, and the reputation it has attained for good workmanship is well borne out by the fine exhibit of this firm at the World's Fair, which

EXHIBIT OF THE CHICAGO BELTING COMPANY.

These latter are operated by electric motors, supplied with current from a set of Partz batteries at the south end of the exhibit. Most of these are operated from the motor by means of belts, but one of them has its flexible shaft directly connected to a small Lundell motor. This adaptation is an interesting one, and attracts considerable attention.

Surrounding their space on the other three sides are tasteful glass showcases and tables for the display of the various types of dental and medical appliances for which this company has become so well known, not only in the United States, but throughout the world. On either side of the entrance is a pyramid of packages

of the sulpho-chromic salt and sulphate of magnesia, the chemicals used in the Partz battery, and the latter is numerously shown both in commission and out. Its various parts are separately shown, together with samples of the types adapted to different uses. In one case a couple of these cells are shown, short-circuited, in which condition they have been since this display has been open to the public. Dental chairs, and, in fact, almost everything in the dental line is shown here, but a marked specialty seems to be those appliances to which the electric current has in some way been applied. One of the most unique and useful of these is a little dental drill, electrically operated, and controlled by the finger of the operator. The layman will look upon this as a new instrument of torture, but the dentist will see in it an instrument for allaying pain and doing good, and by which the disagreeable operation may be much facilitated.

EXHIBIT OF THE WAITE & BARTLETT MANUFACTURING COMPANY.

Directly to the south of the above display is another of a similar character made by the Waite & Bartlett Manufacturing Company, of New York. This firm is one of the oldest in the business, and its instruments are already widely known. What has been said in regard to fakes in describing the previous display applies also to this one, and we are happy to say of this as of the other, that there is nothing here shown but the legitimate. Here, too, are shown handsome cabinets for electro-therapeutical purposes, medical batteries and numerous tools, the value of which those skilled in the science appreciate. Perhaps the most interesting and prominent feature of this exhibit is the enormous static machine here displayed, said to be the largest of its kind in the country. This involves a number of new features, some of which bear the patent date of May 9, 1893. It is placed in a handsome oak cabinet with glass sides, and bears the well known imprint of Waite & Bartlett Manufacturing Company, New York. There is, perhaps, no one exhibit in Electricity Building which will prove more attractive to the electro-therapeutist than this large machine, which Dr. Waite takes pleasure in placing in operation for those who take an intelligent interest in such things.

From the Centennial Exposition to the World's Fair.—III.

BY THOMAS D. LOCKWOOD.

In sources of electrical energy our main progress has been, of course, made in the dynamos. The open coil machines of Brush and Thomson & Houston, which, in 1876, had (the latter at least) not arrived, now develop current probably for the greater half of the immense number of arc lights at present in existence; followed closely, however, by the multitudinous forms of machine embodying the closed coil ring and drum armatures of Gramme and Siemens; and the Edison shunt-wound machine, improved into the Hopkinson-Edison machine, has proved to be the progenitor of a host of others.

In knowledge of the physical theory of the dynamo; in appreciation of the principles of magnetism and the "magnetic circuit"; in applying the characteristic curve" idea practically, and in the essentially practical study of armature actions and reactions, and dynamo designing at large, the progress made has been of the solidest and most gratifying character.

Perhaps in the whole realm of applied electricity there

is no branch of work that owes so much to the joint labors of the electrician, the electrical engineer, the mechanical engineer, the physicist and the mathematician as does modern dynamo construction.

And the machine so produced and perfected has rewarded in due course the labors bestowed upon it, for it alone has brought about economical generation of current electricity. It is not speaking wildly to say that had we still, in the production of electrical currents, been restricted to the use of a fuel which costs twenty times as much, weight for weight, as coal, and whose potential energy relatively is so small, we should still be in the dark ages of industrial electrical science.

The scope, limitations and sphere of the primary chemical battery is perhaps more truly understood than ever before, although the brand of philosophers who can get twice as much energy from a pound of zinc as any one else can from a ton of coal is not absolutely extinct. The principal improvements since 1876 are the invention of the Fuller cell, the general substitution of sodic for potassic bichromate in bichromate cells, and the extensive introduction of oxide of copper as a depolarizer.

The secondary chemical cell, or accumulator, has, however, been made practical by Messrs. Brush, Faure, Sellon, Julien and others, and though so far it has had a checkered career, it still has for some years past crept steadily into use and favor, and is now doing excellent service in many ways. As an auxiliary in small lighting systems, as a dynamo steadier, as a means of isolated house lighting, and as a supply source for telephone transmitters, the storage cell has an ever increasing field of usefulness spread invitingly before it.

With the general introduction of machine-produced currents the arts based on electro-chemistry have leaped forward.

Electrotyping has become general; electroplating has been applied to the useful and ornamental arts in a thousand ways, and for the production of thousands of articles not dreamed of seventeen years ago; and the electrolytic refining of metals and other electro-chemical metallurgical processes have gone into use to a prodigious extent; while the use of the dynamo as a current generator for such arts and processes, though in 1876 a wonder-inspiring rarity, is by this time all but universal.

Among influence electrical machines, the Wimshurst machine is a substantial improvement.

The marked difference between it and older forms is that both plates are rotated in opposite directions, and each plate, therefore, is alternately the inducer and the induced, as its sectors change their relations; the speed and the rate of reaction are virtually doubled; hence the machine, regardless of atmospheric conditions, is more trustworthy in excitement and more rapidly attains its full power.

In telegraphy, almost our oldest industry, the chief onward steps appear to me to have been: The practical system of multiple telegraphy and the beautiful associated synchronizing methods of Delany, described in our own records; the successful duplexing of long submarine cables; the introduction into America of the Wheatstone automatic system; its duplexing; the many small but collectively important improvements in circuits and apparatus, which have steadily raised the speed of transmission by automatic methods; the wellnigh universal substitution of the dynamo for the chemical battery as a source of current; the general introduction of hard drawn copper line wire, and the immense increase in the amount of plant in use, and service rendered, indicated by the fact that while one company alone, which in 1876 had in use 183,832 miles of line wire and 7,072 offices, and transmitted 18,729,500 messages, by the end of 1892 has increased its length of line wire to a mileage of 739,105, the number of its offices to 20,700, and the number of its messages sent to 62,387,000, there has still been room for another, founded in 1881, to reach a point where, in 1892, its business amounted to 9,335,000 messages, earning more than $3,000,000.

In the case of the speaking telephone—the foster-child of the Centennial Exposition—the comparison is still more striking, since the figures of 1892 are to be compared with zero quantities in 1876.

The first line ever constructed purposely for use as a telephone circuit was finished April 5, 1877, and was about two miles long.

The first experimental telephone exchange was operated May 17, 1877, and the first commercial telephone exchange was opened in February, 1878.

Yet at the beginning of the current year, in the United States alone, half a million telephone instruments and 450,000 miles of line wire, 100,000 of which were under ground, were employed for the transmission in one year (1892) of 600,000,000 messages between 232,000 stations, giving at the same time honest and congenial employment to 10,000 persons.

The remainder of the world has a number of telephones in use and a mileage of conductor slightly in excess, but the messages sent per annum appear to be slightly less than the figures given above.

Aside from the growth of the business itself in all of its branches, we may profitably note the exact methods of construction, which, adopted in late years in both lines and instruments, have enabled the telephonic engineers of the Old World to plan and put into successful operation the London-Paris line, having some thirty miles of submarine conductor, and more recently the Belfast-Glasgow line, with its 23 miles of cable, and their brothers of the Western Hemisphere to plan, build and work with commercial success lines extending between Chicago and Boston, in connection with exchanges and exchange lines at each terminal station.

The use of copper wire in this art also has proved to be an invaluable improvement; and the methods of constructing parallel lines so that they may be inductively neutral reciprocally, as well as with respect to extraneous systems, are of the highest consequence.

Our increased knowledge of alternating currents and the phenomena of self-induction has exerted a beneficial effect on the art of telephony, and is of the first importance in the operation of multiple telephonic or composite telephonic and telegraphic systems, which, by the inventive genius of Black, Rosebrugh, Jacob and Van Rysselberghe, and by the work of the telephonic electrician and engineer, have become practically successful.

The photophone and other exemplifications of radiophony, though still void of practical application, serve as a beckoning hand calling the explorers of nature's mysteries forward to new triumphs.

We may, indeed, consider, in view of the universal employment of the telephone; in view of what it is, has done and may yet be expected to do, that in it we find realized and outstripped that wonderful ear trumpet of Tom Hood's poetical tale, concerning which its vender veraciously states that

> Mrs. F.,
> So very deaf,
> That she might have worn a percussion cap
> And been knocked on the head without hearing it snap
> I sold her a horn, and the very next day
> She heard from her husband at Botany Bay.

In electrical periodicals addressed to the English speaking and reading races, we find that while the "Telegrapher" of 1876 scarcely survived that year, and while the "Journal of the Telegraph," having fulfilled its mission, has resolved itself into a tariff circular, the "Operator" has by successive steps become metamorphosed into The Electrical World, and the field of American electrical journalism has also been entered and is admirably occupied by the periodicals bearing respectively the names of the "Electrical Engineer," the "Electrical Review," the "Western Electrician," "Electric Power," the "Electrical Age" and "Electricity."

In Great Britain the sub-title of the "Telegraphic Journal" has displaced its quondam associate, and the old established journal has long been known as the "Electrical Review," while the "Electrician," started in 1878, and the "Electrical Engineer," some years later, are also excellent papers.

Each department of electrical activity can now boast of its own special collection of literature, and books on all subjects have proved the truth of Solomon's conclusion that "of making books there is no end," so that the question What shall we read? must soon by the practical engineer be changed to What shall we leave unread? Whatever else, however, we do not read, we should always make a point of reading a good periodical, and also the proceedings of the several institutions or societies to which we may belong.

The British Society of Telegraph Engineers in 1880 added to its title (as better befitting its constituency and work) the words "and Electricians," and in 1889 assumed its present title and dignity of "The Institution of Electrical Engineers." It had at the beginning of the present year a total of 2,152 members of all classes, an increase of 1,389 since 1876.

The American counterpart of this society, the American Institute of Electrical Engineers, has had so far but nine years of life, yet it has already nearly 700 members, its growth having been conservative, but solid and satisfactory.

This record would certainly be quite incomplete did it not consider briefly the changes which, during seventeen years, have occurred in the United States Patent Office so far as they relate to electrical science.

In the United States Patent Office—one of the most enduring monuments to the wisdom and provision of our fathers—there was in 1876 no electrical department, and applications made for patents which concerned that and cognate sciences were assigned to the philosophical instrument division.

The entire number of electrical patents granted from the creation of the Patent Office up to January, 1876, was but 2,161.

In 1875 the applications filed for patents on all classes of inventions amounted to 21,638.

Patents and reissues were granted to the number of 14,837.

The amount of cash received from the public was $743,453.36, and the amount of cash expended, $721,-657.71. The surplus for 1875 was $21,795.65, and there was already a balance in the treasury to the credit of the Patent Office amounting to $886,909.62.

By the year 1884, however, we find that the Patent Office (which in a sense may be considered as an instrument acting to indicate the industrial progress of the country) issued some 1,200 electrical patents per annum; that the total number of patents on all subjects applied for within the last preceding year had advanced to 35,422; while those granted amounted to 20,297; and that by reason of a regular annual surplus of receipts over expenditures the office had to its credit in the Treasury the sum of $2,781,695.28.

The office has continued to increase the amount of business done, and at the beginning of the Columbian year still reflected the perpetual advance of the domain of applied electricity.

The little sideshow in the division of philosophical instruments of 1876 has developed into two great divisions, which are further divided into a number of classes and these subdivided into nearly two hundred sub-classes.

From the beginning of 1876 to the beginning of 1893 there were granted the immense number of 21,000 electrical patents.

During 1892 the number of applications filed was 40,644.

The total number of patents granted was 23,478, and of electrical patents alone 2,211, while the balance of cash to the credit of the office in the Treasury had grown to $4,179,910.

From January 1, 1876, to the end of 1892, there were granted in round numbers the following patents: In arc lighting, 900; in incandescence lighting, 800; for miscellaneous appliances, related directly to lighting, such as systems, circuit arrangements and fixtures, more than 1,000; and for indirectly related inventions, about 500.

In electric welding and similar metal working (although prior to 1886 the art was not created) during the same period there were granted 220; and on electric railway apparatus, 1,680 patents.

And in telephony we had patents for telephone instruments proper to the number of 700, and for telephone appliances and subsidiary inventions 2,100, besides a host of others for supposed "induction killers," protective devices, and similar devices intended for use directly or indirectly in the art.

In considering the influence which great inventions exert, and the stamp which they impress on the race and time, the congenial, instructive and relatively remunerative employment which they provide for large numbers of persons should be fully taken into account; and this cannot be properly appreciated unless we keep before our mental vision the circumstance to which I have already adverted, that really great inventions do not stand alone, but invariably, owing to the natural processes of improvement, auxiliary invention and rivalry, prove but stepping stones to thousands of others.

It is, however, abundantly evident that, without the patent system, even burdened as it is by imperfection, and by the sins of omission and against light of successive congresses, the inventive genius of the people would have remained dormant, and but little progress would, on this side of the Atlantic, have been made during the past century in the direction of developing the tremendous industries which now aid largely in maintaining the wealth, power and influence of the nation.

I mentioned that in 1876 no college or technological institute taught electric engineering. It need scarcely be recalled to the readers of The Electrical World, many of whom are men who have with credit superadded the knowledge of practical life to the training received in the principles of electrical science, and in the modes of making such principles in the highest sense useful, while attending universities and technological institutions, that now every such institution which respects itself, and which aims to keep in the foreground, has a course in electrical engineering, and that the profession stands to-day on a level with the older engineering professions in point of dignity, and far before them in promise.

This article does not profess to tell about the work and exhibits in the Columbian Exposition itself, since the able pens of the electrical press have already forcibly and eloquently told much and will tell whatever more is necessary, but it does desire to call attention to the facts that while the Centennial Exposition had but a meagre display, all told, of electric appliances and productions, the Columbian Exposition has an immense building devoted exclusively to the science and to the arts founded thereon; and that while the Centennial could not be open to the public after dark by reason of the impracticability of properly illuminating it, the Columbian Exposition will undoubtedly be much more glorious by night than it possibly can be during the day, because only in the darkness can the multiplied transmutations of the light of the ancient sun be enabled to manifest themselves in the millions of electric lamps of all types which bestud the several buildings and which make their headquarters in the building of electricity.

Many even of our own profession are so young in years that if they stop to reflect upon the matter at all they will find it difficult to realize that the Centennial had none of the many practical adjunct devices operated by electricity which make the Columbian Exposition inconceivably brilliant and attractive.

For in reality the great illustration of electrical progress is not confined within the four walls of the building of electricity, but equally consists of the many useful appliances and instrumentalities to be found in each several building, and in the illuminating apparatus, much of the utilizable power, the telegraphic and telephonic

facilities, the fire alarm instruments, the illuminated fountains, and the thousand and one other wonders which are to be found in the buildings and grounds.

And while it is impossible to record in fitting language the immense advances of the last seventeen years, it is often possible to indicate by a diagram things and processes which cannot be clearly explained by words. The Columbian Exposition is a diagram so indicating electrical progress.

A Sensation in Electric Heating.

BY JULES NEHER.

In the issue of The Electrical World of June 10, 1893, an interesting account of a new process for electric heating and welding was given. The experiment is based on the quality of an iron kathode, heating up very rapidly in a cell, whose electrolyte is acidulated water and whose anode consists of a leaden cylinder, a current of about 200 amperes at 120 volts passing through. I have experimented on the same subject in the laboratories of the Westinghouse Electric and Manufacturing Company, and would like to add a few words to this article. The experiments lead me toward a somewhat different explanation of the heating effect. In the article referred to, the resistance of the hydrogen coating generated around the iron is alone said to produce the speedy heating of the iron kathode. In one of my experiments I sent 300 amperes at 125 volts through this cell without obtaining any considerable heating of the iron, the total energy being consumed by the electrolysis of the water and the heating of the electrolyte. This was the case when the iron kathode was immersed before the current switch was closed, so that the hydrogen coating was present, but practically effected no heating.

By closing the switch before immersing the iron the whole experiment is changed; the moment the iron touches the water surface the amount of hydrogen generated separates the liquid from the metal and an arc is drawn. The luminous effect of this arc drawn under water is most brilliant and especially striking when insulated wire is used instead of the bare iron rod, thus producing an arc in one point only, and wholly under the surface of the water.

The apparatus used had about the following dimensions: A plain glass jar 8 inches high and 5 inches in diameter was filled with water containing 25 per cent. sulphuric acid. The positive pole consisted of a ⅛-in. sheet lead cylinder, the edges standing apart about 2 inches, so as to allow the inside of the cell to be seen. The iron kathode consisted of a ⅜-in. round iron bar connected to the dynamo cable and fastened to a wooden stick. Several tests gave results as follows: With 20 amperes at 150 volts a weight of 15 grammes of wrought iron was brought to a melting heat in 15 seconds, the iron actually dropping down to the bottom of the jar, which was covered by a disc of lead so as to protect the glass from the hot iron.

The approximate efficiency can be calculated as follows: An amount of heat, H_1, is consumed in the iron; an amount of heat, H_2, is conscumed in the water, and an amount, H_3, is lost by radiation and conduction; a certain amount of energy (E) is further consumed in the electrolysis of the water. In 15 seconds the temperature of 15 grammes of iron was raised about 2,000 degrees C., and 1,500 grammes of water 3 degrees C. This gives

$$H_1 = \frac{2{,}000 \text{ degrees} \times 15 \text{ grammes} \times 0.1138}{15 \text{ seconds}} = 250 \text{ gr. cal.} =$$

1,048 watts.

0.1138 being the specific heat of the iron.

$$H_2 = \frac{3 \text{ degrees} \times 1{,}500 \text{ grammes} \times 1}{15 \text{ seconds}} = 300 \text{ gr. cal.} =$$

1,257 watts.

E (consumed for the electrolysis) = 20 amperes × 1.5 volts = 30 watts (assuming 1.5 volts to be the counter E. M. F. of the cell). Total watts = 2,335.

The total available energy being 20 amperes × 150 volts = 3,000 watts, we still have 665 watts, equal to 159 gr. cal., to dispose of for H_3, which is about equal to 29 per cent. of H_1 plus H_2, the total utilized heat.

The efficiency is thus found to be approximately 35 per cent., as 1,048 of the 3,000 watts are utilized in heating the iron. These calculations cannot certainly be considered exact, but are about as near as possible in this case.

Other metals, as copper and lead, are heated and melted quicker or slower, according to their conductivity for heat. Carbon is heated in a very short time, but the melting off of amorphous carbon could not be obtained, and this phenomenon is seriously doubted by the writer.

The heating by the arc under water is evidently an advantage over the heating in the atmosphere only because of the thorough heat-insulating quality of the hydrogen coating obtained around the iron, and because of the combustion of this gas at the surface of the liquid. The hydrogen actually burns in leaving the water electrolyte and a part of this heat is conveyed into the iron. Taking this additional heat into consideration, the efficiency of the process is still lowered, but at the same time the whole energy proves to be made better use of, the product of the electrolysis being utilized again for the heating purpose.

Using a low E. M. F., 100 volts for instance, the heating is scarcely perceptible, although the current is about the same, probably because of the gas coating being thinner and the arc not long enough; 125 volts seem to be the critical voltage.

By changing the poles we obtain oxygen on the iron kathode, which forms explosions in combination with the hydrogen chemically developed by the contact of iron and sulphuric acid. In this case the heating of the iron is again very low, probably because the amount of oxygen is only half the amount of the hydrogen disengaged in the reversed case, the gas coating not being thick enough to produce an effective arc, as was the case with the lower voltage.

The practical advantage of the process is undoubtedly in the total absence of oxidation of the heated metal, and this feature might probably lead to an extensive use of the process. For the experimenter the phenomenon of wrought iron melted like wax in a glass jar filled with water is one of the most striking.

The Economy of Street Railways.

BY JAMES B. CAHOON.

In a previous article on "The Economy of Small Lighting Stations" illustration was given of the meaning of the word economy as applied to small stations. The same illustration applies very aptly to the electric street railways of the present day. The rapidity with which the old horse railway has been remodeled into an electric railway, the great extensions and consolidations that have taken place, together with the projecting and building of entirely new roads, has been something marvelous in its vastness even in this day of great accomplishments. Europe stands looking in open-mouthed wonder at the dare-devil way in which Americans are pushing the development of electric street railways.

Quite recently, in talking with an English electrician, he asked me the question: "Where do you obtain electrical engineers for all these roads?" to which I replied: "Ninety per cent. of the electrical roads in the country are run without any electrical engineer." This he almost took for an insult to himself, and thought I was attempting to guy him, but when I reiterated my statement, and convinced him that it was true, he said: "They cannot be paying much of a dividend, for their coal and repair bills will be so great as to eat up all the profits."

There is a great deal of truth in what this gentleman said, for I am perfectly confident that it is not stretching matters if I say to the managers of the roads who have no electrical engineer that their coal bill is nearly twice, and their repair bill three times, what it ought to be. An instance has come under my notice where quite a large road changed over from horse to electric power; contracts for the power house were awarded to an electrical contractor, and as he was after dollars and not fun, and they had no electrical engineer to watch him and see that the contract was properly made in the first place and carried out as it should be, we find many shortcomings, as, for instance, the foundations for their engines and dynamo, which of all things at the station should be of the very best construction, are built with Rosendale cement, and one would judge the mixers neglected to wet their stone and brick, as a person can readily kick out the smaller pieces of stone from the rubble, and it certainly will not be many years before it will be absolutely necessary to replace these foundations entire.

In this locality, where the first cost of water is quite high, no attempt was made to save the water, but the steam was condensed by a common jet condenser of about the cheapest kind in the market.

The feed water is heated to about 120 degrees F., and the boilers are stoked by hand. No provision was made for weighing the coal, and the manner of carrying off the waste gases from the boilers was unique, to say the least, being carried directly by all the nipples in the ends of the tubes in the boilers. This will, undoubtedly, cause leakage before long, and then will commence an endless amount of trouble with the boilers. The management of this road were strongly advised to secure the services of a first-class engineer, at least during this period of reconstruction, and were also informed that they need not hesitate to do so on the score of economy, because the engineer would save his year's salary every month. They could not see this, and instead of employing a competent man got a young man who had had a couple of years' work in college and about a year in a small lighting station, and placed him in charge of the electrical part of the road, the reason given being that they could get his services for about one-fourth what they could the other man, and he knew enough anyway to do what he was told.

Another instance brought to my knowledge by an engineer of several years' experience was a reply to his application for the position of chief engineer of a new road that is about to be installed. The management told him they did not think they needed the services of an engineer, that, in fact, they did not propose to have any electrical men other than the dynamo tenders. This road will probably run 40 or 50 cars to start with, and must certainly increase in the future.

Another case was a reply to an engineer who applied for the position of engineer and superintendent of a road which is about to be installed, and is as follows: "Dear Sir—The plant and appliances of the —— Electric Railway have been pretty well considered and are in no way complicated, and we hardly think the services of an expert electrician would be necessary. We, therefore, will likely select a man for superintendent from some of our people in the town who have ordinary mechanical knowledge and skill, and who would be familiar with local conditions necessary to attract travel to the line, etc. Regretting that there seems to be no opportunity to consider your application, etc."

These instances are not unusual, but may be taken as a fair criterion of the way owners of street railways look upon the necessity for the employment of an electrical engineer. Let me ask these gentlemen, Would they spend thousands of dollars in the equipment of a factory for manufacturing purposes and then appoint as superintendent one who knew absolutely nothing of manufacturing or the machinery pertaining to it? The natural reply would be in the negative. Again, Would these gentlemen purchase a triple expansion Corliss engine of 2,000 h. p. for this plant, and put in a shoemaker to run it? Electrical machinery is of even more delicate construction than the finest of steam engines, yet the management of a road select a man to control the operation of their fine engines, dynamos, motors and boiler plant, who knows nothing about electricity, and very likely little or nothing of steam engines and steam generation; still they expect economic results and good dividends. The electrical department is not properly organized. Motors are neglected until they actually cry out, repair bills keep on increasing, and cars seem to consume an enormous amount of current, all for lack of intelligent supervision. Does it ever occur to these men that from one-fourth to one-third more power than necessary is generated only to be wasted in the street in every direction? As an instance of this, I call to mind a case that was reported to me not long ago from one of our Western cities, where an electrical engineer who was visiting friends in town was asked by the president of the street railway to inspect his plant and point out the causes of the failure of the road to show a dividend though carrying more passengers than two years ago. At the power house he found a consumption of 10.8 pounds of a rather dirty quality of bituminous coal per h. p. hour. Opening one of the fire doors he found the firemen were shoveling the coal into the centre of the fire and heaping it up until it almost touched the crown sheets. Going along to the engines he listened to the big engine for a moment and said to the engineer: "Let me see one of your last indicator cards?" The engineer finally confessed that he did not know what an indicator card was; he had never taken one. The electrical engineer told the president, who was accompanying him, that the engine was not working as it should, on account of the valves being improperly set, entailing considerable waste of energy, and before doing anything more it would be better to get the engines to working properly and the firemen instructed how to fire soft coal. The engines were indicated, valves reset, and, under the engineer's supervision, a two-days run was made, the coal and refuse being carefully weighed. The consumption of coal was brought down to 5.6 pounds per h. p. hour, good, clean, bright looking fires being kept under the boilers. It was recommended that a competent engineer be obtained, and also that at least two first-class firemen be employed, even if they had to be paid $3.50 per day. Continuing his tour of investigation, going into each detail very carefully, he found many leakages; a poor return path for the current, the original return wire having been completely destroyed by electrolytic action in several places, and the rail bonding tested out very poorly indeed. A very careful report on each item was made by the engineer. When the president came to read this and see the numerous causes for loss of power, he said he no longer wondered why the road did not pay a dividend, but he did wonder how in the world it ever paid expenses even, and felt he had made a very grave mistake in not employing a competent electrical engineer to look after the property before, and in future he should certainly do so. This man has been converted to the necessity for the employment of a competent engineer considerably in advance of the great majority, as there seems to be no one class who are so hard to convince of the necessity of such a thing as these very men who are the head and front of the street railway work of the present day. Numerous articles have been written, earnest protests have been made by the whole electrical profession, but in vain, apparently. The only thing that will convert them to use the same common sense in dealing with electrical matters as they do in their own business will be time and the realization, as time goes on, that their properties are not earning the dividends that the business should warrant. In the meantime the thing for the electrical profession to do is to continue to raise the standard of excellence in engineering, and at the same time earnestly and persistently strive to impress on the general public the fact that electrical apparatus must not be left to the care of any schoolboy or ordinary mechanic who chances to apply for a job; for, being of different construction, and having rules differing from other machinery, it requires, when massed in any quantity, the care and supervision of intelligent electricians.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Electrostatic Hysteresis.—The Lond. "Electrician," June 23. reprints an article by Mr. Arno, from the Italian, on the dissipation of energy in the rotating electric field and on electrostatic hysteresis. He refers to a former paper (see Digest, Feb. 4), and describes an apparatus for the study of this phenomena; it consists of a small hollow cylinder of ebonite hung by a bifilar suspension between four segmental plates of copper, which produce the rotating field; the rotation was dampened magnetically, and was measured by the usual mirror and ray of light; the whole was inclosed with a disc of calcic chloride in a metal case connected to earth: the energy consumed was measured; a difference of potential from 5 to 18 volts and a field of 0.95 to 3.33 electrostatic C. G. S. units were used; he found the law to be $W = H F^{1.6}$, in which W is the energy absorbed, F the intensity of the field, and H a constant, the exponent 1.6 being found from 14 determinations. This exponent differs from that required by Hess's theory of conducting particles, and tends to confirm the hypothesis of the dissipation being due to hysteresis.

Mutual Attraction of Vacuum Tubes.—Sir David Saloms, in the London "Electrician," June 23, stated that he accidentally found the presence of an attraction between two vacuum tubes which far exceeded what theory would lead one to expect, if due only to static effects or to the mutual action of the currents; he attributes it to purely magnetic effects and promises a more complete investigation. He found that two vacuum tubes attract one another strongly, the attraction being almost, if not quite, the same whether they touch one another along the whole length or only at their ends; a spiral tube sucks in a core tube, which becomes less luminous the more it is drawn in, the core tube not being connected to the circuit; when placed end to end they attract one another and stick together: no repulsion takes place, which would occur if the effect were of a static nature: this attraction is the same no matter what position the tubes have: in all the experiments one tube had the current induced by the other.

Luminosity in Vacuum Tubes.—Mr. Rimington, in the London "Electrician," June 23, discusses the cause of luminosity in vacuum tubes; the article is of interest, but the explanation is not altogether satisfactory. In speaking of the air as a conductor he states that it does not conduct like a piece of metal but rather by convection, something like an electrolyte or like a lot of pith balls between two charged plates, the dissociated atoms taking the part of the pith balls.

Multiplying the Frequency.—The translation of the article by Mr. Korda, mentioned in the Digest, June 10, is published in the London "Elec. Eng.," June 16.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Congress Proposals.—The "Elek. Zeitschrift," June 23, contains the discussion of the American proposals at the Elektrotechnische Verein, of Berlin. The discussion was limited almost entirely to the report made by the committee of that society (see Digest, June 17 and July 1) with the object of accepting or modifying it; as it was finally accepted with but slight modifications the discussion contains but little of importance. Mr. Dobrowolsky objected to defining the ohm by the mass of mercury instead of by its cross section; Dr. Weinstein proposed that as in the case of the kilogramme, which is not the theoretically correct value, the ohm to be adopted should be considered as equal to the theoretically exact value in order that later determinations may be adopted without the necessity of a formal adoption at a congress; his motion, however, was rejected by the society. A number of points were discussed, but they are unimportant; among them was the question of writing m for minutes, on which point it was decided not to make any recommendation and to modify the report accordingly by omitting the recommendation to write 60 seconds instead of minutes; objections were made by Mr. Dobrowolsky to the suggestion to add an asterisk, thus kg* to distinguish a kilogramme of force from a kilogramme of mass, and it was decided that some distinction should be made; one suggestion was to write the one kg and the other Kg, as there are objections to using an asterisk; this was objected to, as it was not applicable to the gramme; it was finally moved and adopted to use the asterisk as originally recommended; Dr. Kalischer subsequently suggested to double the letter g in referring to force; Mr. Dobrowolsky recommended that only the letters J, E, R be adopted for current, voltage, and resistance respectively, and that no action be taken about recommending any others; his motion was rejected; Dr. Budde said that such adoptions at a congress were recommendations rather than laws. Regarding the unit of light and illumination the president, Mr. v. Hefner-Alteneck, spoke at length about his lamp, which was recommended in a modified form in the American proposals, and stated that in his opinion it would be a mistake to alter its dimensions in order to make it equal to the bougie-decimale; difficulties arise in comparing lights of different colors, and it would therefore not be practical to standardize the amylacetate from the platinum standard. Mr. Uppenborn announced that he had been asked to recommend a change of date in the congress and suggested that the society recommends it be changed to September 15; his motion was adopted.

The report of the French committee, abstracted in the Digest, July 8, is published in "L' Ind. Elec.," June 25. Mr. Hospitalier adds a few editorial remarks in which he says that he does not agree with the conclusions of the committee in disapproving of the substitution of the name "henry" for the name "quadrant;" the name "quadrant" is not in accordance with the adopted system of naming electrical units after distinguished men of science; it is furthermore an erroneous term, as it connects a coefficient of induction with the idea of a length, which is not correct; in the electromagnetic system a coefficient of self-induction has the dimensions of length, and is measured in centimetres, but this is not the case in other systems of units, as in the electrostatic system, for instance; for these reasons he recommends the adoption of the name "henry."

Legalizing Electrical Units.—Dr. Wachsmuth, of the Imperial Technical Institute, replies in the "Elek. Zeitschrift," June 23, to the article of Mr. Dobrowolsky (see Digest, July 1), regarding the suggestion to define the ohm by the cross section instead of by the mass of mercury; he states that in practice it is not possible to measure the cross section with sufficient accuracy and that therefore the other alternative had to be resorted to; he also replies to the other criticisms, but gives little of interest and nothing new; regarding the watt and the joule he believes that the former is the more important and that the latter should be deduced from it.

Fundamental Units.—Mr. Felix Lucas, in "L'Elec.," June 17, discusses the fourth fundamental unit which he suggests adding to the unit's mass, length and time. (See Digest last week.) After showing which is the best choice to make for this unit he gives the dimension of all the magnetic and electric quantities in terms of length, time and two other units without introducing the unit mass.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating Current Transformers.—The Lond. "Electrician," June 23, publishes a short article by Dr. Sumpner, in which he gives a very good brief summary of the subject of transformer design: the article is well worth reading in its entirety. Among the formulas given are the following:

$$W_h = \eta\, n\, \mathbf{B}^{1.6}\, U \times 10^{-7}$$

in which W_h is the loss of power in watts due to hysteresis in the core; U is the volume of the iron in cubic centimetres; $\mathbf{B}$ is the maximum induction density in C. G. S. lines per square centimetre; η is Steinmetz's coefficient and n is the frequency:

$$v = 4.45\, S\, \mathbf{B}\, n\, 10^{-8}$$

in which v is the number of volts (mean) induced in any single turn of wire, S is the area in square centimetres of the section of the magnetic circuit; if the core consists of m iron wires of circular section, the specific resistance of the iron being ρ, the length of the magnetic circuit l centimetres and the number of watts W_e the loss in eddy currents is

$$W_e = \frac{v^2\, l}{25\, m\, \rho}.$$

If there are m plates in the core and if the section of each plate is m' times as long as it is thick then

$$W_e = \frac{v^2\, l}{a^2 m\, m'\, \rho},$$

in which a is a number which varies between 10 and 30, according to the value of m'; in ordinary transformers the latter is very large and $a = 12$ is the most probable number; the value of ρ for transformer plates may be taken as 13×10^{-6} at ordinary temperatures; it increases by nearly a half per cent. for every degree centigrade; the number of watts wasted per cubic centimetre of the core by eddy currents is equal to

$$\left(\frac{8\, v\, t}{S}\right)^2,$$

in which t is the thickness of the plates in millimetres; for this Dr. Fleming gives the formula $(n\, t\, \mathbf{B}\, 10^{-8})^2$, in which t is the thickness in English mils. The thickness should not exceed 0.5 millimetre, the general practice being to use them slightly thinner; if thicker the eddy currents disturb the distribution of the lines of force so that the hysteresis losses are greater and the eddy currents become excessive. The average ampères required to magnetize the core to a maximum induction $\mathbf{B}$ with n_1 turns in the primary is very approximately

$$A_m = \frac{l\, \mathbf{B}^{1/5}}{10\, n_1},$$

in which l is the mean length of the closed magnetic circuit in centimetres, and in which $\mathbf{B}$ lies between 1,000 and 6,000; values much smaller than the latter are now favored in general practice. If V_1 is the primary voltage, the actual open circuit current will be greater than the above by

$$\frac{W_h + W_e}{V_1}$$

owing to the loss in the core. If W be the load in watts taken from the secondary coil at the voltage V_2, the secondary current is $A_2 = W \div V_2$, and the primary current at this load is

$$\sqrt{A_1^2 + A_m^2} \text{ where } A_1\, V_1 = W + W_h + W_e,$$

and the loss of power in the coils at this load is

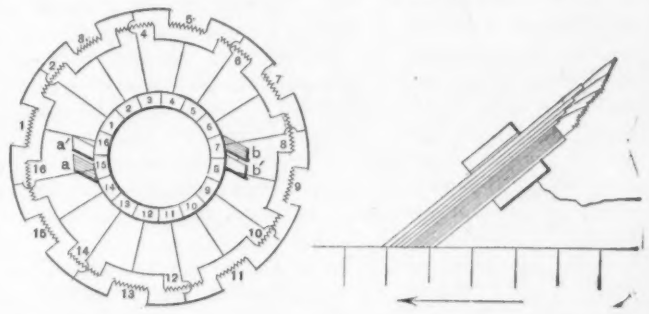
$$W_c = (A_1^2 + A_m^2) r_1 + A_2^2\, r_2,$$

in which r_1 and r_2 are the resistances of the primary and secondary coils. The drop of voltage bears the same ratio to the voltage V_2 on open circuit as W_c bears to W, a ratio which, in good regulation, should not exceed two per cent., and which should be divided equally between the two coils. This equality can be secured by making the weights of copper in the two coils practically equal. The insulation of the coil increases their space by fully 50 per cent for the primary coils and by about 10 per cent. for the secondary. It is advisable to strand the secondary; the current density frequently lies between 700 and 1,000 ampères per square inch. The efficiency of the transformer in per cent. is

$$100\left(1 - \frac{W_h + W_e + W_c}{W + W_h + W_e + W_c}\right).$$

The core losses $W_h + W_e$ are constant for all loads; the efficiency will be greatest when the load is such that $W_c = W_h + W_e$, that is, when the iron losses equal the copper losses; a radiating surface of the transformer from three to four square inches per watt is required; on account of the light load of long duration the highest average efficiency should be secured by diminishing the iron losses at the expense of those in the copper; the chief consideration with small transformers is to make the ratio of W_c to W so as not to exceed two per cent.

Alternating Current Motor of Hutin and Le Blanc.—"La Lum. Elec.," June 10, publishes a full description of this motor, accompanied by six illustrations. It appears from the article that this motor is, like many of those described by these inventors, in the nature of a proposed motor, as distinguished from a practical commercial motor ready to be put into the market. This motor is intended chiefly for distribution of small units of power; it is based on the principle of the electro-dynamometer (that is, the principle of the ordinary motor); in order to overcome the objection to the short-circuiting of the coil by the brushes, he employs a double winding as shown in the accompanying diagram connecting each winding with every alternate commutator



WINDING AND BRUSH OF HUTIN AND LE BLANC MOTOR.

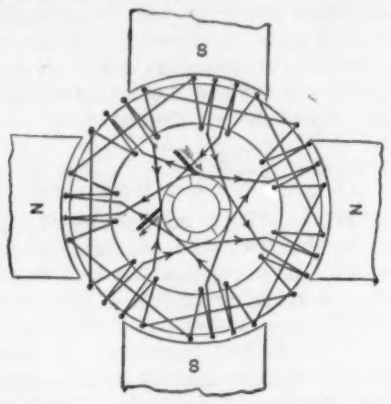
bar; unless the brush covers three commutator bars, a coil is never short-circuited (each circuit, however, is then broken alternately by the brushes and it is a question whether the cure is not worse than the disease). It is claimed that the present arrangement does the same thing as a condenser would do in overcoming the effects of self-induction, the use of a condenser being excluded as they are not practical. It is stated that theoretically there ought to be no sparking (!), but that practically there was; it is claimed that this can be made to disappear completely by using the brush shown in the accompanying figure in which the upper laminæ are insulated from each other on their faces, and connected at their upper ends with each other through resistances, the object of which is to gradually reduce the current before breaking the circuit (a device which might also be used to advantage on continuous current machines). It is stated that this motor can be started as easily as a continuous current motor; it is claimed that the sparking is reduced to nothing, and that the apparent self-induction is practically zero. Several diagrams, showing this double winding and a somewhat modified winding of the field, are given in the original.

Rechniewski Dynamo.—"L'Ind. Elec.," June 10, publishes an illustrated description, accompanied by data and results of a number of tests of this dynamo which possesses some features of novelty and interest; as is well known the fields of these dynamos are made of laminated iron and the armature has large deep teeth. The present form has four poles, although in external appearance it resembles a two-pole machine. In the tests made, the connections of which are given, two machines were coupled mechanically, one being driven as a motor from an external source and the current from the other was discharged into a dead resistance; this arrangement was suggested by Ravenshow as a modification of the well known Hopkinson arrangement.

Alternators.—"L'Ind. Elec.," June 25, contains an article by Mr. Roux, describing and illustrating the alternators of Kingdon, Ewing, Pyke & Harris and Balloni; the first three have been described in these columns; the latter consists essentially of a ring armature wound like a Gramme ring through holes near the peripheries; the magnets which form the revolving part are formed somewhat like a bell magnet with an interior pole, or like the figure formed by

a U magnet revolved around one of its arms as an axis; the pole faces are provided with a number of polar projections made of sheet metal and staggered with respect to one another, each pole therefore lying opposite to the spaces between the two polar projections on the other side of the ring armature; only one exciting coil is required for this form of multipolar field; it is claimed that the magnetic resistance is very low; it contains, however, four magnetic joints and air gaps; the machine is illustrated in the original article.

New Winding for High Voltage Machines.—Mr. Baumgardt, in the "Elek. Zeitschrift," June 9, describes a new winding which is a sort of combination of a drum and a ring armature; it is shown in the accompanying cut; it will be noticed that there are more wires on the outside of



New Winding for High Voltage Machines.

the ring than in the inside; it is intended chiefly for large machines of very high voltage; in this four-pole machine the voltage will be higher than it would be for the ordinary winding.

Transformer Experiment.—Mr. Uppenborn, in the Lond. "Elec. Rev.," offers the following explanation of Mr. Kennedy's experiment (see Digest, July 1): A well known theorem states that movable pieces of iron always arrange themselves in a magnetic field, so that the number of lines passing through them may be as large as possible, and therefore the iron pieces in this experiment repel each other, as the lines of force then passing through them are greatest; the coefficient of mutual induction increases with the number of lines of force, and consequently also the E. M. F. in the secondary coil. In view of this explanation, he thinks that Mr. Kennedy's phenomenon loses all its noteworthy character. Mr. Kennedy, in replying to Mr. Morley's explanation (see Digest, July 8), states that he believes it to be the correct one, for, when the plates are apart, many lines of force enter them by their sides or flat surfaces, while, when pressed together, they enter at the edges only; this may be shown with iron filings; the effects occur whatever plates are used, and also with the plates of a closed magnetic transformer.

Traveling Crane with Triphase Motor.—"L'Ind. Elec.," June 10, and "L'Elec.," June 17, describe and illustrate a large traveling crane recently erected by the Oerlikon company, which is operated with triphase motors.

ARC AND INCANDESCENT LIGHTS.

Illumination from Arc Lights.—Mr. Guy's serial in the Lond. "Elec. Eng." contains the following table, in which "half arcs" refer to arc lights of a "nominal" 1,200 c. p., and "full arcs" to those of "nominal" 2,000 c. p.; by A is denoted an illumination just sufficient to see the way about, the light being only just enough to work by when close to the lamp; it is sufficient for railroad tracks, canal banks, etc.; B denotes an illumination sufficient to carry on ordinary work as in railroad sidings, sheds, docks, foundries, streets, etc.; C is a good strong light for ordinary indoor lighting; D is for places where an extra good light is wanted:

	Half arcs.			Full arcs.		
Intensity of light.	Height in feet.	Radius in feet.	Area in square feet	Height in feet.	Radius in feet.	Area in square feet
A	30	114	80,000	40	170	100,000
B	30	68	16,000	40	76	20,000
C	15	24	2,000	15	34	4,000
D	15	17	1,000	15	24	2,000

Arc Lamp.—The Lond. "Electrician," June 16, describes and illustrates in a brief note the Harp lamp, the mechanism of which appears to be unusually simple, involving some novel ideas; the drop feed is used and as there are no long carbon-holding rods the lamp is very short; it can be used for both alternating and direct currents, in series or in multiple.

Night Navigation on the Suez Canal.—Nearly 91 per cent. of the vessels passing through this canal do so at night by means of the electric light. According to the Lond. "Electrician," it will be made obligatory that such vessels must hereafter use an apparatus for dividing the light of the projector into two divergent rays in order to avoid blinding the eyes of the helmsmen of two approaching vessels.

RAILWAYS.

Electric Traction at Havre.—According to the French journals the horse car lines in Havre are to be replaced by trolley lines installed by the European Thomson-Houston company. The total length is about 11½ miles, much of which is double track; 40 cars are to be used.

INSTALLATIONS, CENTRAL STATIONS, ETC.

Electricity Supply in London.—In an editorial the Lond. "Electrician," June 23, gives some very interesting deductions, accompanied by a few very complete tables from the Board of Trade Reports of the London stations. Only a few figures can be given here, those who are interested being referred to the original. The total metered output during the last year was 7,915,746 kilowatt hours, an increase of about 84 per cent. over the preceding year; the total receipts were 225,790 pounds sterling, an increase of 57 per cent. The cost of coal per kilowatt hour supplied in the different stations was as follows: London Electric, 4.72 cents; House-to-House, 4.2; Electricity Supply, 3.82; Metropolitan, 3.6; Chelsea, 3.4; St. Pancras, 3.33; Notting Hill, 2.71; Westminster, 2.09; St. James and Pall Mall, 1.89; Kensington and Knightsbridge, 1.84. The figures are based on the coal bills. Last year this table divided itself into those above 4 cents and those below 4 cents, the former being all alternating current systems, and the latter continuous current systems, with the exception only of the Chelsea company.

Electric Lighting.—The Lond. "Electrician," June 16 and 23, reprints a somewhat lengthy paper by Mr. Lane, the president of the Belfast Gas Institute, in which he discusses the subject from the standpoint of a gas engineer; it is to a great extent directed against electric lighting.

Water Power Station.—"L'Elec.," June 3, gives a short description, accompanied by illustrations comprising four elevations of three water power stations, preceded by a discussion of the subject of turbines.

Accumulator Regulator.—The Lond. "Elec. Rev.," June 23, publishes a translation, including five well selected cuts, of the Trumpy regulator, mentioned in the Digest, July 1, and used in the municipal station at Berne.

WIRES, WIRING AND CONDUITS.

Underground Conduits.—In the Lond. "Elec. Rev.," June 23, Mr. Carter, in his serial on arc lighting, discusses the subject of underground pipe conduits, accompanying the same with a number of cuts.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Preece on the Telephone.—The London "Elec. Eng.," June 23, reprints an interview with Mr. Preece from the "Pall Mall Gazette," in which he states among other things that overhead lines for the telephone are absolutely indispensable, while for electric light he condemns them altogether; telephoning would be absolutely impossible for long circuits with underground wires; with our present knowledge he says it would be absolutely impossible to speak between London and Birmingham through an underground circuit; there would be no difficulty whatever in speaking between any two places in the United Kingdom if overhead wires were allowed; the use of earth in any form is the great bugbear of telephony. He proposes to establish at Leeds a telephone exchange with which every chief town in the kingdom will be connected so that it will be possible for any town to speak with any other; the work in the towns themselves will be done chiefly by the telephone company, but in towns where there are no exchanges the government will take charge of it; the latter will have charge of these long distance lines; he thinks it would have been better if the whole service could have been under the management of one administration.

Telephone in Sweden.—The Lond. "Elec. Eng.," June 23, contains a note from the British consular reports from which it appears that the cost of the underground cables laid by the government, namely, 2¾ cents per metre per subscriber, is not more than that of overhead cables; the iron tubes usually used are dispensed with; Mr. Hultman, the chief government inspector, states very emphatically that it is a mistake to use, for the sake of cheapness, single grounded lines instead of double metallic circuits; the well known superiority of the Stockholm telephone system is said to consist mainly in the high grade of instruments and workmanship; great care is taken in regard to the efficiency of the employés; every day an inspector goes the rounds of the subscribers, makes a call and notes the number of seconds with a stop watch before receiving an answer from the exchange. A record is thus kept of the efficiency of each of the employés.

D'Arsonval Transmitters.—"L'Elec.," May 25, gives a description accompanied by good working illustrations of the new form of d'Arsonval transmitter at present used largely in France.

Telephonic Communication with Lightships.—The Lond. "Elec. Eng.," June 23, reprints a paper by Mr. Rochford, in which he gives briefly the results of a number of trials that have been made.

Telephone Companies and Electric Traction.—The English journals for June 28 publish a summary of evidence before the English Parliamentary Committee regarding the subject of the metallic return; it includes the examination of a number of prominent electricians.

ELECTRO-CHEMISTRY.

Accumulators.—In a note in the Lond. "Elec. Eng.," June 23, taken from "Revue Industrielle," a description is given of a new process of preparing the active material, invented by Mr. Boese; the metallic oxides are mixed with sulpho-combine acids of anthracene and other organic compounds, forming the mixture into plates; in practice the residue of coal tar is used, being transformed into sulphur combinations by extracting the petroleum ether, adding sulphuric acid, distilling the solvent and provoking the formation of the desired compounds; alcohol may be used instead of petroleum ether for extracting the residues of distillation, so that by mixing the product with the sulphuric acid and a metallic oxide the heat given off is sufficient to provoke the chemical action on the hydrocarbons contained in the alcoholic extract; such plates are said to acquire great stability on account of the agglutinative properties of the salts.

The "Elek. Echo," June 17, contains an illustrated article, taken from a publication of the company making the well known Tudor cell.

Cadmium-Salammoniac Cell.—A note by Mr. Ditte on this subject, read before the French Academy of Sciences, is reprinted in "L'Elec.," June 3.

Electrolytic Purification of Sugar.—"Electricite," May 18, mentions a process in which a current is passed for a few minutes through the warm liquor between electrodes of zinc; on the positive electrode a heavy muddy precipitate will be formed, which falls to the bottom. The current produces a coagulation on the albuminoids which hold all the other material in suspension; the oxide of zinc formed combines with the various organic substances; the precipitate contains one-third oxide of zinc; no zinc is contained in the resulting solution of sugar.

Manufacture of Iodine by Electrolysis.—"Electricite," May 25, describes briefly the Parker and Robinson process.

Electrolysis of Aluminium.—In the conclusion of Mr. Haubtmann's serial in "L'Elec.," June 3, he describes the Minet and the Hall processes.

MISCELLANEOUS.

Lead Poisoning.—Referring to the voltage existing between the gas and water pipes (see Digest, July 8, under Telephony) the "Lancet" suggests that the electrolytic effect of such a current may cause traces of the lead to find their way in solution in the water, and that this might prove to be an unsuspected source of lead poisoning. (In the first place, the lead is not "dissolved" by such an electrolytic action unless the earth contains a *solvent* of lead, in which case the dissolution would occur even if there were no current; in the second place, this current passes from one pipe to the other through the earth and therefore effects only the external surface of the pipes and not the internal, except possibly to a very slight degree through long high resistance water circuits of small cross section back through the reservoir and the pumps to the ground, the water in the pipes being connected directly to the earth only in the case of a leak; last, but not least, the electrolytic action between iron and lead in an electrolyte is to oxidize the iron and not the lead, the latter being reduced, which renders it all the more insoluble; it seems, therefore, that this statement in the "Lancet" is not based on a sound knowledge of the conditions, and unnecessarily alarms those who trust its opinions.)

A New German Electric Railway.

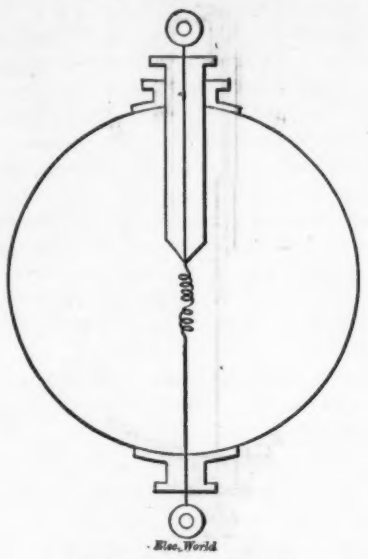
The electric railway built for the city of Hanover, Germany, by the firm of Siemens & Halske, of Berlin, using 13 cars, was put into operation on May 20, and the working of the system is said to be exceedingly satisfactory, particularly the easy motion of the cars and the simplicity of the overhead system. The trolley contact arrangement used is one manufactured for many years by the Siemens & Halske Co., and permits of an exceedingly simple arrangement of the overhead wires on curves, etc. This consists of a roller of almost the width of the car, carried by a frame pivoted in two standards, one on each side of the car. Contact is maintained by either a spring, or a weight on the lower part of the frame, or both. When the motion of the car is reversed the frame automatically takes the proper position for the new motion. Among the claims for this form of trolley is that the wear on the trolley wire is reduced, and contact is not broken by considerable displacements of the trolley wire or in going around curves. The system has been introduced on two other lines, the Koenigswoerther Platz-Herrenhausen Stoecken and Linden-Simmer, on which 18 motor cars are in use, and it is intended to add a number of trailers. The power station is at present fitted for 500 h. p., but this can easily be increased with the expected extension of the system.

A Large Alternating Lighting Station.

The Missouri Electric Light and Power Company of St. Louis, now four years old, has a capacity for 45,000 incandescent lamps, which is about one-half of the total number of lamps the company has on its circuit. The present equipment consists of nine 3,000-light and two 6,000-light Westinghouse alternators; but with the new style of armature placed in the machines their capacity has been increased over the rated power. The engines are 250 and 600 h. p. Westinghouse compound, and there are fourteen Babcock & Wilcox 250-h. p. water tube boilers, three Hooker feed water pumps, four Berryman feed water heaters and two large surface condensers made by the company. A 12,000-light, direct coupled alternator has been ordered and additional steam machinery. Helios arc lamps have been introduced on the circuits with much success.

The Oconto Incandescent Lamp Case.

What has become known as the Oconto case, which is another of the series of litigations growing out of the Edison lamp patents, owing to alleged infringments of the same, and of which the Beacon case, at Boston, and the Columbia case, at St. Louis, are too fresh in the memory of our own readers to require more than mere mention here, has now become a matter of history, so far as the arguments are concerned, and only awaits the decision of Judge Seaman to take its place as perhaps the most remarkable trial in a most remarkable series of preliminary hearings upon a subject



DEMOLEYN LAMP, 1841.

which has more nearly involved the whole fabric of industrial electricity than anything else that has ever in the past, or is likely to in the future, to come before the courts.

The Beacon case attracted wide attention from the start from the fact that there was presented the first real defence since Judge Wallace's decision upholding the Edison patents for the exclusive right to manufacture incandescent lamps involving the features of a high resistance carbon filament inclosed in an all-glass receiver in which was maintained a high vacuum. These features, it will be remembered, were those upon which the Edison patents were based, and they had been upheld by the highest courts of record. The defence in the Beacon case was what has become known as the Goebel defence, and maintained that the features upon which Edison had been awarded priority of invention had all been anticipated by Heinrich Goebel and been embodied in lamps made and publicly exhibited by him in the early fifties in New York city. The boldness of the claim, and the general demoralization of the electrical industries due to active prosecution by the General Electric Company of the infringers of its patented right as awarded by the courts of record, startled everybody, and it may be said with truth, we think, that no trial has been watched with more breathless interest in the annals of patent litigation than was this one on the petition for a restraining order against the Beacon Vacuum Pump and Electrical Company.

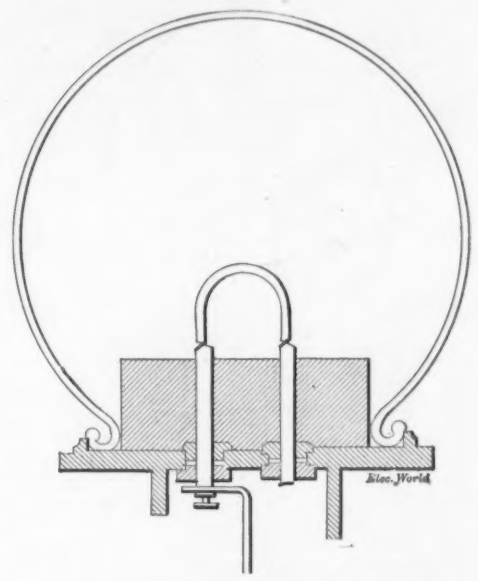
The failure of the defence to make their case was regarded by many as a deathblow to the Goebel defence, and so certain were a number of the lamp manufacturers that such was the case that immediately upon notice from the General Electric Company that suit had been entered against them of the same nature, some of them closed their factories and went out of business.

The Columbia Incandescent Lamp Company, of St. Louis, however, was not one of these. It at once prepared for trial, making the same defence as did the Beacon company, viz., the Goebel defence. The Columbia case however, was the same as the Beacon case only in that the Goebel defence was set up. This defence had been much strengthened in the intervening time, and new testimony and additional exhibits were procured, all tending to strengthen the claim of an anticipation by Goebel of all that was essential in the Edison patent. In other respects, viz., the manner of use of this defence, the Columbia case was quite different from that of the Beacon case, it being maintained that the questions involved had never previously been adjudicated. In previous litigations the question at issue had been that of the construction of the second claim of the Edison patent purely, while this, it was claimed by the defence, was purely one of infringement, which hinged upon the question as to whether or not the defendant had proved that a filamentary carbon, as defined by Judge Wallace, had been used and was known in the art previous to Oct. 12, 1879—the Goebel and corroborative testimony being used to show that such a filamentary carbon was known in the art prior to 1879. While there were other collateral points involved, it was the contention of the defence that the whole case rested primarily upon this question, and their energies were, therefore, bent chiefly in this direction.

As before stated, the public took little interest in this trial, for the reason that it had assumed that the Goebel defence was untenable. So little importance was attached to this case that The Electrical World was the only journal of any kind represented in the courtroom. The reports which our esteemed contemporaries published the following week were all cooked up in their own editorial sanctums and bore so little resemblance to the truth that those which presented the fullest accounts deserved credit only for the possession of greater fertility of the imagination. The Electrical World alone of all journals, technical or otherwise, was present throughout the trial, and in its issue of April 22—the following week—published a very full report of the proceedings, covering six pages of its paper, which remains to this day the only correct report of this interesting and far-reaching trial. The importance of this trial, however, was realized by every one on the succeeding week when Judge Hallett rendered his decision, declining to grant the injunction against the Columbia company, and thus practically throwing open to the public the incandescent lamp, and breaking, for the time being, the strong monopoly which it was feared by many threatened the very existence of the electrical industry.

The above digression is warranted by the fact that out of that case grew the present one, which will prove not less important, whichever way it may be decided; nor is this, in fact, a digression, but rather an explanation which is really essential to the proper understanding of what follows.

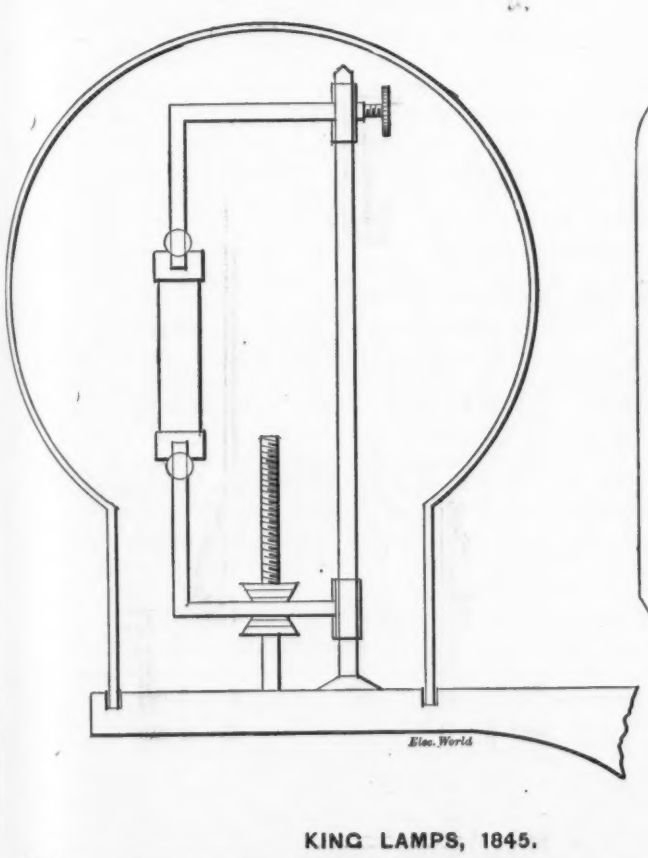
In both these cases all of the testimony was given by affidavit, as is usual in such cases, but testimony thus secured is not satisfactory for many obvious reasons, and always gives a loophole through which the unsuccessful contestant may crawl out and comfort himself, as it allows him to claim that had his adversary's witnesses been under oath and subject to cross-examination, the true facts would have been elicited and assigned their true importance. That evidence on the witness stand is much more satisfactory than that by affidavit is universally admitted, and the fact that those who gave the new evidence in the Oconto case were cross-examined lends to it an importance far in excess of that attaching to previously supplied testimony, and since the new evidence on the part of the complainants is in support of their previously more than hinted at claim that the Goebel evidence and exhibits were fraudulent, the present case practically amounts to a reopening of the case, and gives it an importance not enjoyed even by that of the Beacon case. The public have not understood this, however, nor have our contemporaries, evidently, for not a representative of one of them has seen fit to be present throughout the trial at Milwaukee. The Electrical World is, therefore, again the only journal to present an authentic account of what took place at the trial, which it will now proceed to do.



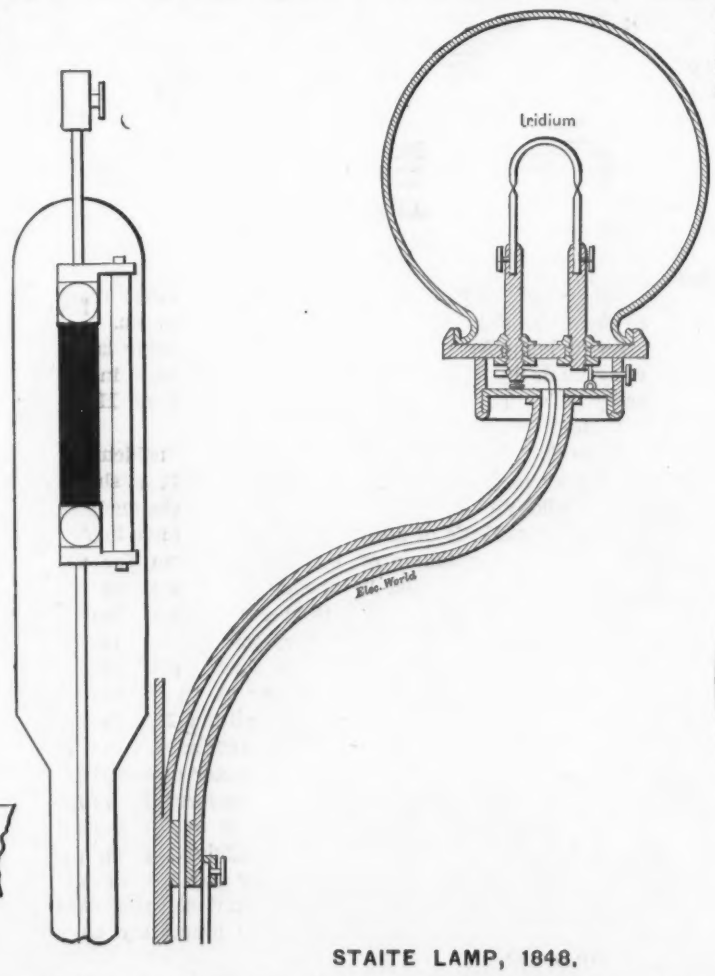
STRAITE IRIDIUM LAMP, 1848

The case has been on the calendar for some time. Previous to the Columbia trial the Electric Manufacturing Company, of Oconto, Wis., manufacturers of incandescent lamps, had been closed down by a restraining order at the instance of the plaintiffs. Believing that the questions involved and issues presented in the Columbia case were the same as those at bar, the defendants applied for a modification of the restraining order, which should permit them, upon executing good and satisfactory indemnity bond, to continue until final hearing the manufacture of their incandescent lamps. Notice was consequently served upon the complainants on May 13, 1893, by W. H. Webster, solicitor for defendants, that the latter would apply to the Hon. Wm. H. Seaman, Judge of the United States Circuit Court for the Eastern District of Wisconsin, at the United States Circuit courtroom in Chicago, May 16, 1893, at 9 a. m., for an order in the above entitled action setting aside and vacating the restraining order heretofore issued in this suit. Several postponements were obtained through various causes until the suit finally came up for trial before Judge Seaman at Milwaukee on July 3.

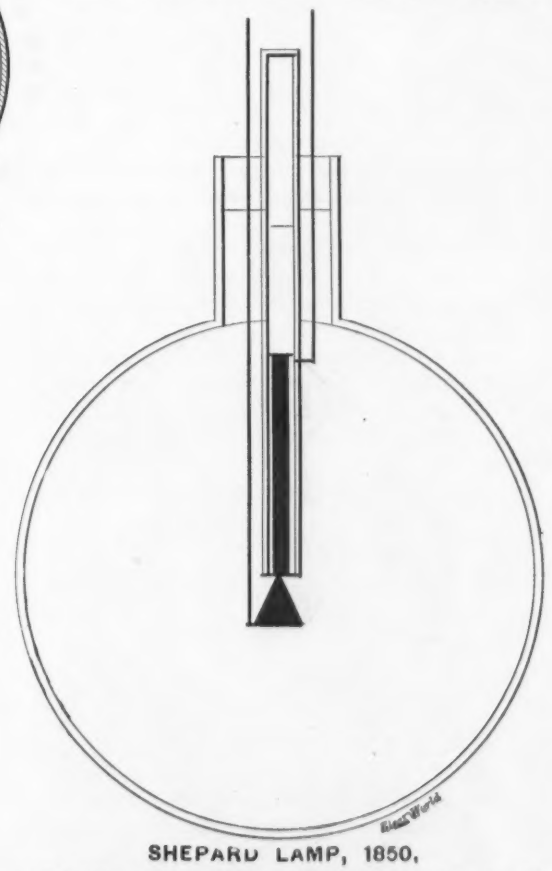
Pretty much the same counsel on both sides were pres-



KING LAMPS, 1845.

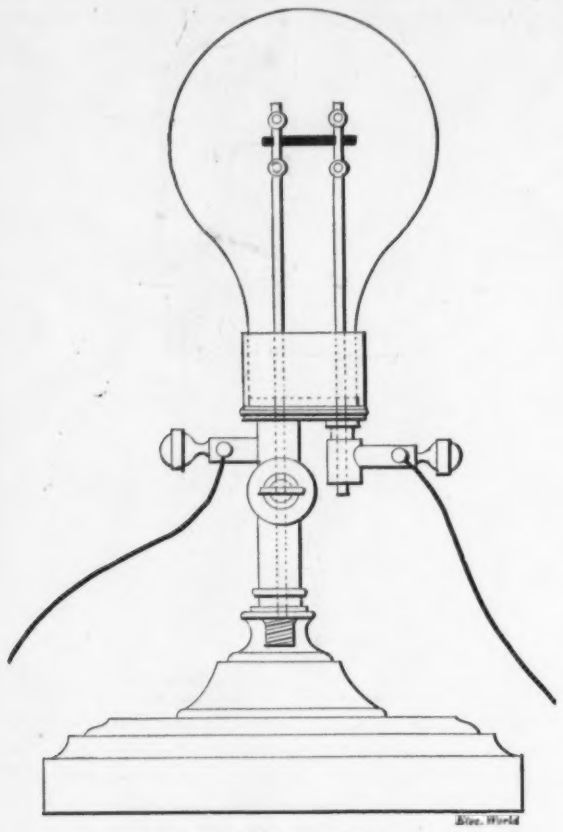


STAITE LAMP, 1848.



SHEPARD LAMP, 1850.

ent as in the other cases—those war-horses, Frederick P. Fish and Richard N. Dyer, for the complainants, and Witter & Kenyon and A. P. Smith for the defence, being very much in evidence. Mr. C. A. Seward, who formed such a striking figure both at Boston and St. Louis, is absent in Europe, and he was very much missed. Mr. Charles E. Mitchell, however, is the new face on the side of the complainants, and the vigor of his arguments attests to the value of this acquisition. H. G. Underwood, solicitor for complainants, and Wm H. Beale, of counsel for Chicago, complete the list of

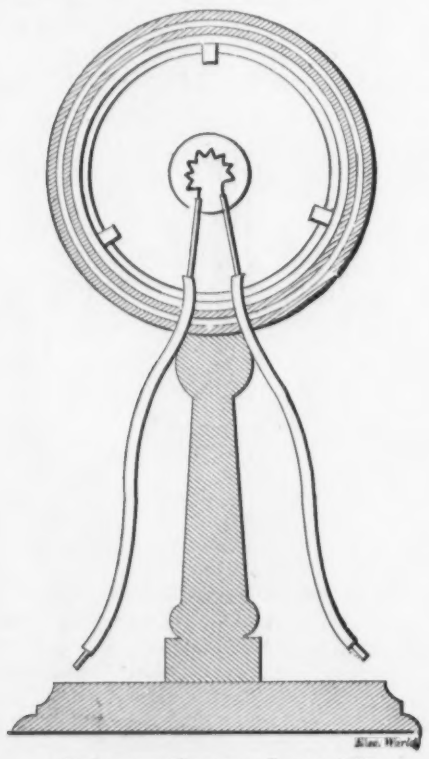


ROBERTS LAMP, 1852.

counsel on this side. W. H. Webster is the solicitor of record for the defendants and is the only new face on that side.

The rebuttal of the new evidence introduced into this case was by deposition only. The time in which this could be collected being limited and the witnesses scattered rendered it necessary that the depositions should be taken simultaneously in New York, Milwaukee and California. The legal force of both sides was, therefore, necessarily divided, and some other names new to this litigation have in this way been introduced. Thus, in taking depositions, the complainants were represented in New York by Wm. H. Meadowcroft, Eugene H. Lewis, L. H. Latimer and Major Eaton. In California D. H. Driscoll represented the General Electric Company and L. W. Seely the defendants.

From the very start it became evident that each point of supposed advantage was to be bitterly con-

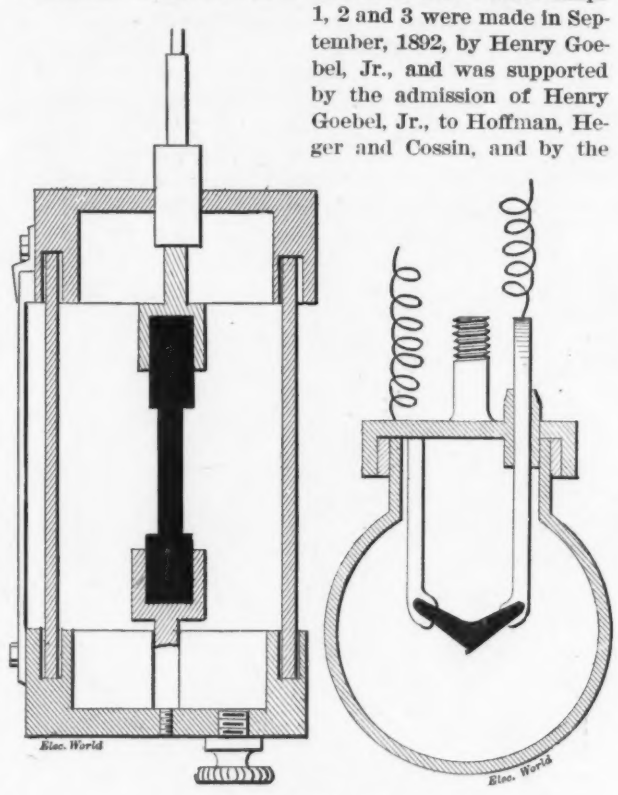


GARDINER BLOSSOM LAMP, 1858.

tested, and a foreshadowing of the heat that was to be displayed was given at once. Defendant asked leave to amend its answer, for the reason that the developments in the Columbia case had really placed both parties in different relation to the suit. Plaintiff objected strenuously to such an amendment, claiming that in the original answer the defendant admitted infringement, while in the amended answer it denied infringement. It was submitted, therefore, that by the amendment it sets up a new defence, whereas the defendants had produced no new affidavits to change the case, and were therefore seeking to take a fictitious position. To this Mr. Witter replied that in the original allegation, as it appeared in the Beacon and Columbia cases, it was claimed that the defendants made a lamp which, under the ruling of Judge Wallace, was the lamp of the plaintiff. Under that ruling he admitted infringement. The Goebel structure, however, was now part of the art, and therefore the Edison patent must receive a narrower construction than that given it by Judge Wallace, and according to that narrower construction there was no infringement, for the reason that the defendant used the Goebel lamp. Mr. Witter further claimed that prompt and adequate notice had been made to plaintiff long ago of the desired amendment, and he therefore was in position to make the request.

Plaintiff argued that it was immaterial what the answer was, provided only that it appeared on the record, together with the reason why the amendment was made, and the defendant should state in affidavit just what its position was, and ask the court to so rule. Mr. Witter had never heard of such a thing as filing an affidavit for such a purpose, and claimed that it could not be required. The Court sided with Mr. Witter in this, and allowed the amended answer to be admitted without going into the details, stating that the original answer also remained to appear for what it was worth.

The new evidence introduced by the complainants' Milwaukee affidavits was to the effect that Goebel lamps 1, 2 and 3 were made in September, 1892, by Henry Goebel, Jr., and was supported by the admission of Henry Goebel, Jr., to Hoffman, Heger and Cossin, and by the



KONN LAMPS, 1872.

purchase of the glass tubing with which to make them, as shown by the affidavits of Heger and Schumann.

As to lamp No. 4, that this and other similar lamps were made by Heger when working for Goebel in the early '80's. This is shown by the affidavits of Heger and Hoffman.

As to the planer, Goebel exhibit No. 6, and incidentally other planers, that it was made as late as 1883, as shown by the affidavit of Korwan, who claims to have made it, and by the affidavit of Heger, who claims to have known the fact. The affidavit of Fitzpatrick, given for the complainants, is claimed by them to withdraw all the corroborative support given to Goebel as to these planers.

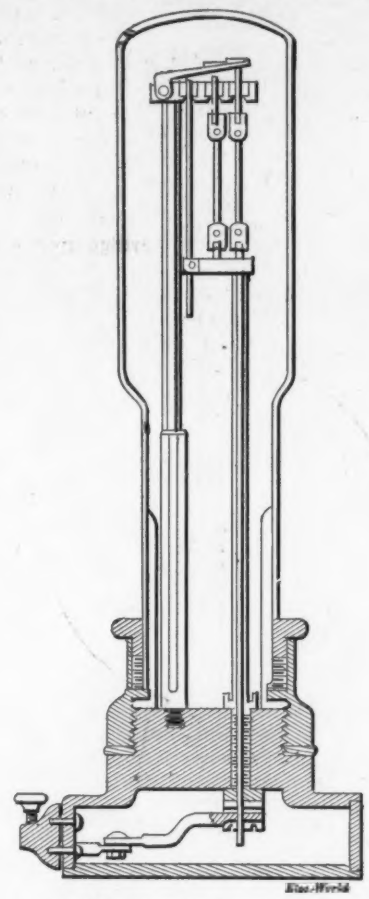
As to miscellaneous matters, they present an affidavit from Azubah Rice discrediting her former affidavit for defendant; one from Joseph Steiner as to statements made to him by Herman Kraft discrediting Kraft's affidavit for defendants; one from Henry Hitchcock showing that the affidavits supporting the character of complainants' affiant Kulenkamp were not considered by Judge Hallett; affidavits from Bate and Russell to a statement by Mary Meisinger discrediting her affidavit given for defendants, and affidavits from Barker and Howell supporting complainants' affiant Upton, and showing that Goebel reproduced lamps A to D are practically inoperative lamps.

The defense admitted in evidence the same exhibits as those presented in the Columbia case, together with all the affidavits procured up to that time, together with some 500 pages of new affidavits and depositions in rebuttal of the new testimony introduced here for the first time by the complainants.

MR. DYER'S ARGUMENT.

Mr. Dyer presented the case for the complainants in a most masterly argument, lasting, with frequent interruptions, until about 3 p. m. Wednesday afternoon. In this he said:

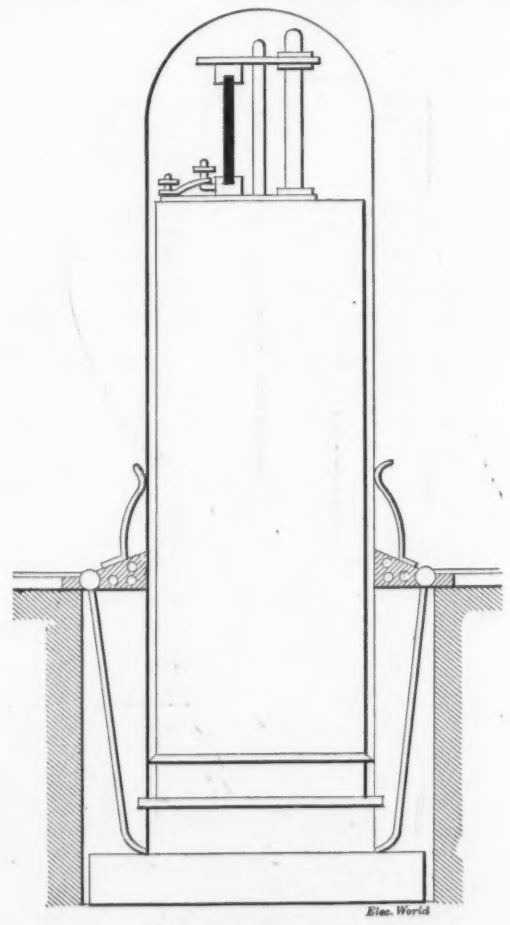
"Your Honor ruled that new evidence since early June should be taken in form of depositions. At that time the defendants admitted that the new affidavits introduced by us, unless successfully answered, disposed of their case. The complainant has shown by its new testimony that the defense set up is fraudulent; that its three principal exhibits, lamps 1, 2 and 3, were made in September, 1892, and the other, lamp No. 4, all of which, it was



KONN-JEUSEN LAMP, 1875.

claimed, were made prior to 1872, was made, like the first three, after Edison's invention, and this is asserted in the affidavit of Heger, the man who made the lamp."

He then pointed out the weak points in the defense as presented in the previous cases. In the argument in the Beacon case nothing had been said about Goebel's tools. At a later date, when it had appeared that such tools would help the case, a set of affidavits was presented claiming for the first time that Goebel had made use of such tools, and that he had used them long prior to 1872. In their new evidence they presented the affidavit of the man who made the tools—Korwan—that he made the first one in 1883, and that he made it to meet the demand which had by that time arisen for such an exhibit. "These affidavits," he said, "took all of the principal exhibits out of the case, proved fraud, and no



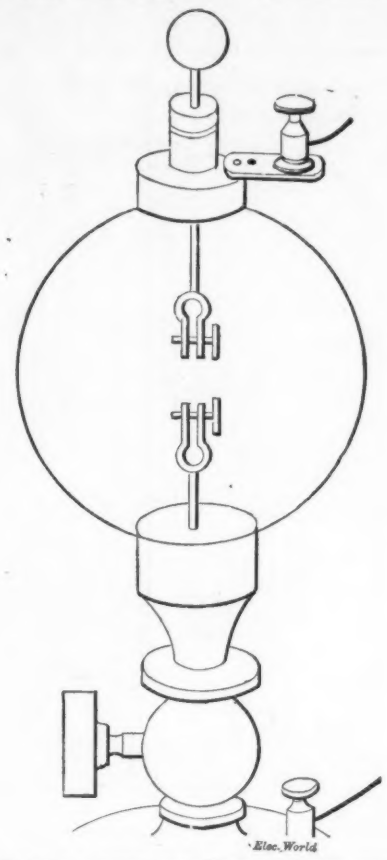
KOSLOFF LAMP, 1875.

wonder the defendants admitted their case was lost if these affidavits were not answered.

SOME POINTS FROM A. F HEGER'S AFFIDAVIT.

"Last year—I think it was in August or September, 1892—a man from the office came to my room and said that some one wanted to see me in the office. I went down to the office and there was Henry Goebel, Jr. . . . He told me he wanted to buy a piece of glass tubing to make some lamps. I picked out a piece from stock. It was about 3 feet long and about 1 inch in diameter. He

asked me to draw the end out, and said that he wanted to make some lamps. . . . I then took the tube upstairs to my bench and drew out the end in a stem several inches long. He said that he could then go on and make the lamps himself. . . . He then took me out to a saloon on the next corner, where we talked the thing over. He said that the lamps he was going to make were for a case, meaning a law case in court, and that

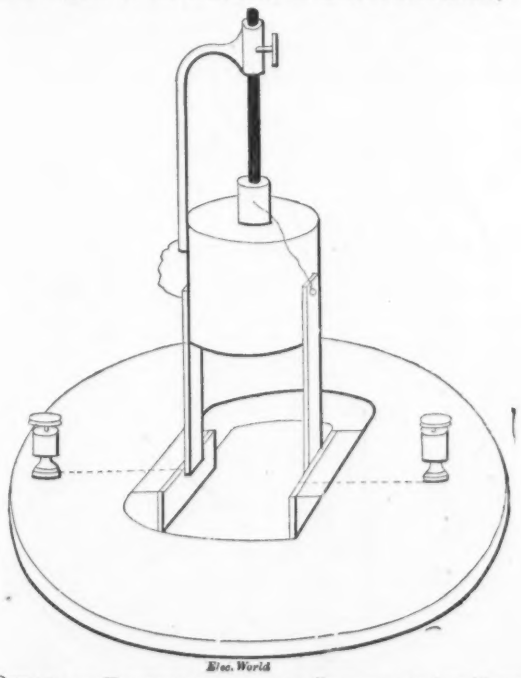


GASSIOT CASCADE USED FOR EXPERIMENTS WITH CARBON IN 1877 BY EDISON.

there would be something in it for me later on, and that he would see me again. . . .

"Some time after the above took place and in January of this year, Henry Goebel, Jr., came to Demuth's shop again and asked me to help him out by making an affidavit in the case. He referred to the same law case which he had talked about at the previous interview. He asked me to go to Witter & Kenyon's law office and to make an affidavit. I did so, and my affidavit was in what was called the Beacon case, and is dated Jan. 26, 1893, which, I believe, was the date when this call at Witter & Kenyon's office took place.

(Heger made two affidavits, the one referred to and another on March 1. In the former he testified to Henry Goebel's skill in the manufacture of carbons, to his skill as a glass-blower, to his having had a mercury pump about 1881, and that it was used for exhausting the air from lamp bulbs. He also testified to having seen at the time at Goebel's store a number of old lamps which he kept in his safe. Among these were some "fiddle-bow" lamps which Goebel told him he had made himself. These he identified as "just like the lamp in the photograph now shown me, the photograph being marked on the back 'Goebel Lamp No. 3.'" His affidavit in March was in regard to the character of Albert Hetschell.)



DETAIL OF EXPERIMENTS WITH CARBON IN AIR PUMP.

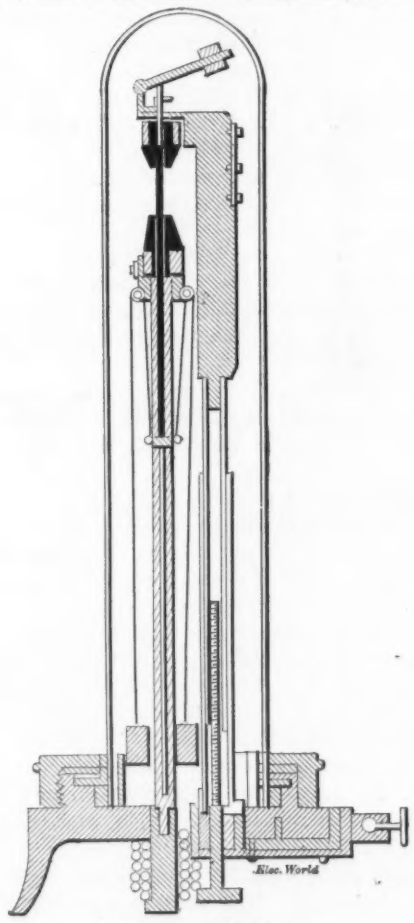
"While we were together at that time he told me that he had made three lamps out of the tubing which he had bougth at Demuth's, the end of which I had drawn out in a stem for him, as I have stated, and that they were to be used in that case, meaning the Beacon case.

"These three lamps which Henry Goebel, Jr., said he made, as I have just stated, I never saw; but he told me that he had made them to go into the case in which I had made my affidavit—the Beacon case—and that they were to be used in that case. He did not say what use was to be made of them, and I had no means of knowing.

"I am now shown a photograph of four lamps, and am told that it is a photograph of defendant's lamp exhibits Nos. 1, 2, 3 and 4 in the Beacon case. As regards the three lamps in the photograph which bear the numbers 1, 2 and 3, I am told that the originals were the identical lamps which Henry Goebel, Jr., told me that he had made, as I have stated. Whether this is so or not I do not know. But these three lamps could have been made from the piece of tubing, the end of which I drew out into a stem for him, as above set forth. The tubing was of the same diameter as these lamps appear to be from the scale shown on said photograph.

"As regards lamp No. 4, on this photograph, it looks exactly like lamps which I made myself early in the eighties, when I was employed by the American company and worked at Henry Goebel's shop at No. 468 Grand street, as I have stated. I then made for him while at his shop lamps like this exhibit lamp No. 4. Those that I made had carbons of the hairpin shape, like this exhibit, and had leading-in wires sealed into the sides. It really seems to me as if I must have made this very lamp, judging from the photograph. But I am not certain of it."

Mr. C. F. Cozzin, a contractor, in whose employ Henry Goebel, Jr., was for about a year prior to September, 1892, testifies: "A few days before Henry Goebel, Jr., left me, as I have stated, he came into the shop with a hand-bag or gripsack. He opened it and showed me three lamps of tubular shape and a pair of flat pliers. I am now shown a photograph which I am told represents Goebel lamps 1, 2 and 3 exhibits in the Beacon case. I believe that the lamps which were in Goebel's bag were these lamps. Certainly these lamps in this photograph look exactly like the lamps which were in the bag. When he showed me these lamps I asked him



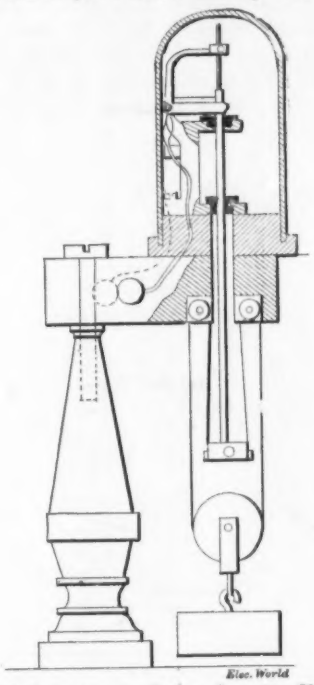
BOULIGUINE'S LAMP.

what he was doing. He said that he had just been making those lamps. He said it in such a way that it aroused suspicion in my mind, and I said to him that the pliers were a dead give-away. He said nothing, but he smiled in a way which satisfied me just what he was doing, which was, as I thought, that he had made those lamps for use in the Edison and Goebel law case he was helping Mr. Bull on. . . . Every time when Henry Goebel, Jr., went out after he first saw Mr. Bull, as I have stated above, he used to show me money when he came back. He used to say that he had made that money since he went out. Sometimes it was a five dollar bill. sometimes a roll of bills, and I was told once that it was twenty dollars."

Max Hoffman, a saloon-keeper, who kept what was known as the East Side Hoffman House, and with whom Henry Goebel, Jr., talked frequently and freely in regard to his business, including the Goebel lamp case, after speaking of his (H. Goebel, Jr.'s) having given him a piece of wire with which to mend a dog chain somewhere about September, 1892, says that after having read in the "New Yorker Zeitung" of Feb. 24, 1893, Judge Colt's decision in the Boston case, he said to him (Henry Goebel, Jr.): "Henry, I see that you lost your case in Boston," to which he replied: "I know that, Max, but how did you know it?" Hoffman replied: "Here is a paper telling all about it." He read it him, and as he got to where the judge stated that the lamp No. 4 made him doubt the whole story about the lamps, he says that Henry Goebel, Jr., interrupted him with: "That is a nice kind of a judge! If he had dropped on lamps 1, 2 and 3, instead of 4, he would have come nearer to hitting the nail on the head. Max, you remember the day I gave you the wire for your dog chain? That is the day I made those lamps. No. 4 was made way back in 1883 by one of the men that worked in father's shop in Grand street."

FREDERICK KORWAN'S AFFIDAVIT.

"I reside at No. 426 Seventh avenue, Brooklyn, New York. I was for thirty years foreman or in charge of tool department of R. Hoe & Co., who had places of business at Grand street, Columbia street and Broome street, New York city. I knew Henry Goebel for many



CARBON FFEDER LAMP (SHOP LAMP), EDISON, 1878.

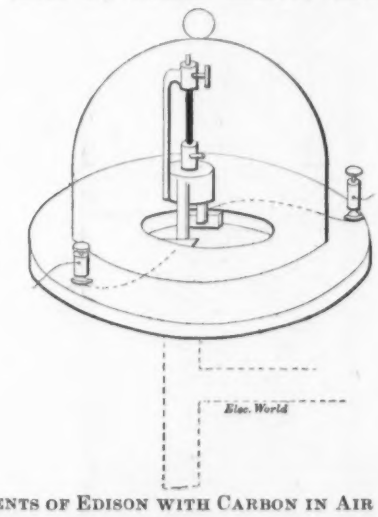
years past. I visited his jewelry store in Grand street frequently, at No. 468, in and about the year 1883. Henry Goebel was then making incandescent lamps. He was cutting the wood for the carbons by hand; they were cut one at a time with a knife held in the hand; that was too slow, and Goebel got up a machine to do quicker work, whereby several could be cut at once, and this machine was cast in Hoe's shops about 1883. Prior to that machine the wood had all been cut by hand, and no machine of any kind had been used. I saw no machine of any kind prior to that time, and if there had been any I would certainly have known it and seen it, as I visited his place often. I am shown a cut, here annexed, of a machine which is like the one made for Goebel, as stated. I am told that this is like what is known as Goeble's planer, Goebel's exhibit No. 6. This is the same machine as made in 1883, as stated."

Max Schumann, above referred to, is bookkeeper for Demuth Bros., and testifies to Henry Goebel, Jr., having bought the tubing and to Heger's having taken the tubing upstairs to draw the end out.

FREDERICK FITZPATRICK'S AFFIDAVIT.

"My recollection of dates is very imperfect, and I cannot recall, with any definiteness, when I did any work for Henry Goebel. I do not recall making any casting for any machine for said Goebel. The only work I recollect doing for him was that of repairing stoves.

"When I made my former affidavit, herein referred



EXPERIMENTS OF EDISON WITH CARBON IN AIR PUMP, 1878.

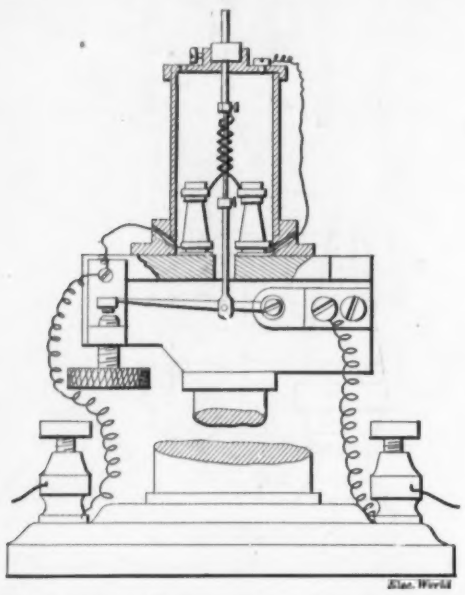
to, I did not, and could not, recognize or identify the machine or apparatus, Goebel exhibit No. 6, or any part thereof. I have no recollection that I ever cast Goebel exhibit No. 6, and I so informed the gentleman who secured from me my former affidavit of Feb. 7, 1893."

(Fitzpatrick had made an affidavit in the Columbia case on Feb. 7, 1893, in behalf of the defendants. In this he said: "I did a good many odd jobs for him (Henry Goebel) between 1850 and 1864. The Goebel exhibit No. 6 was, I think, cast by me while I was foreman for Chas. E. Perley & Sons, ship machinists, ... though there is nothing about it to enable me to say positively that it was my work. I have no doubt I made it if Mr. Goebel says that I did. If I made it while at that place it must have been done between March, 1862, and January, 1865, as I was there during that period only. I may have done it at some other place

prior to April 1, 1862, but I have no distinct memory of it. I did no work for Mr. Goebel after 1864.")

MISS AZUBAH RICE'S AFFIDAVIT.

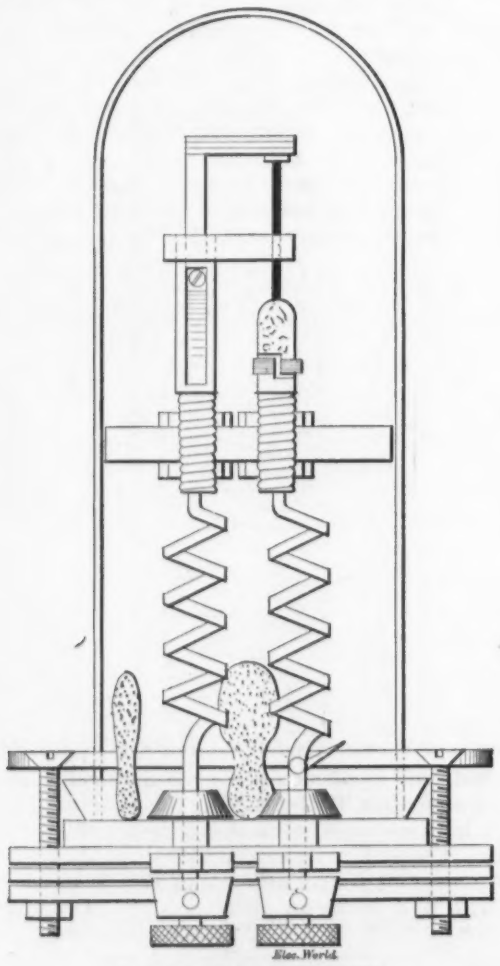
"I reside at No. 60 South Sixth st., Brooklyn, N. Y., and have heretofore, on Feb. 23, 1893, made an affidavit for the defendants in the case of the Edison Electric Light Co. et al. vs. The Columbia Incandescent Lamp Co. et al., pending in the United States Circuit Court for the Eastern District of Missouri. I remember Henry Goebel referred to in said affidavit, and that he was at one time reported to be working on electric lights or lamps, but I do not remember when this was. I have no knowledge or recollection of the form or construction of any electric lamps or lights made or used by Henry Goebel, nor could I identify any picture or photograph of any such electric lights or lamps. I never made any personal examination or inspection of electric lamps



Early Platinum Lamp with Thermostatic Regulator, 1878.

or lights made or used by the said Goebel. I have never made an examination of any electric lamps or lights. I have never used any such thing, and I have no knowledge as to their construction or operation."

(Miss Azubah Rice, in the affidavit referred to, testified that she remembered perfectly the large telescope mounted on the wagon that he used to drive around town—that on the wagon with the telescope he had two lamps suspended from a wire. The light from these lamps was different from anything she had ever seen, and she knew it was not from oil, gas or candle. The lamps glowed just as the incandescent lamps of to-day glow. Described the lamps as of glass tubing closed at both ends and with a loop of wire within,



Sawyer-Man Lamp, 1878.

and pronounced a photograph of Goebel's No. 3 as just like the ones on the wagon.)

Joseph Steiner, an attorney, deposes that he knows Herman Kraft, who made an affidavit in behalf of the defendants, dated Feb. 27, 1893, in the Columbia case, giving a certificate of good character as to Herman Goebel. He annexes a certified extract from the minutes of the Curt of General Sessions, a criminal court in New York City, showing that on May 25, 1875, "Hiram" or Herman Kraft, the person referred to, was convicted by verdict, of grand larceny, and was sentenced to be imprisoned in State Prison of New York, at hard labor, for the term of five years.

He says: "Herman Kraft tells me that he never at any time saw any incandescent electric lamps in Mr. Henry Goebel's store in Monroe street; and that Mr. Goebel never told him that he had made such lamps; and that he himself gave no description of the construction of any such lamps as is set forth in his said affidavit. He says that most of the matters which are contained in his said affidavit were put in without his knowledge, and are entirely different from the statements which he made to defendant's lawyer, who interviewed him and prepared the case, but that he was told when he signed the affidavit that the lawyer had put in only what he had himself told him. He says that the lawyer showed him a box filled with glass tubes, and asked him whether he ever saw any such tubes with a light burning inside in Goebel's possession. He says that he told the lawyer "No." He says that he did not identify, nor was he shown, a lamp marked "Goebel lamp No. 3," and that he did not see any such electric lamps in Goebel's possession, as set forth in this affidavit, nor did Goebel ever explain to him at any time that it was electricity that made the lamps in his place burn, nor that the air inside the glass would destroy the lamps. Kraft told me that these statements which he now finds in his affidavit are untrue, and were put in by the lawyer, without his knowledge.

"Kraft further states that he recollects Henry Goebel's telescope, but that there were no electric lamps upon it.

"Herman Kraft further tells me that Henry Goebel, Jr., was present when he gave his statements to the lawyer who drew the affidavit, and that the said Henry Goebel, Jr., then said that he expected to make a big pile of money out of the case, and that when he got it he would give him, Herman Kraft, some of it.

"Herman Kraft further tells me that he never saw any incandescent electric lights in the time referred to in his said affidavit. . . . He says that he signed the affidavit without reading it, having been told by the lawyer who drew it that nothing had been inserted except what he himself had stated, but that he now finds this was not the case.

"Herman Kraft talked very fully to me about the false statements in his affidavits, but was unwilling himself to make an affidavit contradicting them. He thought it would get him in trouble. That is the reason why I make this affidavit myself."

The affidavits above quoted were none of them read in full, but as they form a large portion of the case and were frequently referred to, their substance, where they are not in full, are here given.

Mr. Dyer claimed that the defendants took testimony in the nature of special pleading. The fact that they did not put Henry Goebel, who claims he made the lamps, on the stand, shows lack of confidence in their own witness. The testimony shows lack of clearness as to where the lamps shown came from. In regard to lamps 1, 2 and 3, he said they had been kept 40 years without breaking, but that they had cracked while bringing them from somewhere to the lawyer's (Bull's) office. Henry Goebel, the only person who could make the story satisfactory, had not been used. In speaking of lamp No. 4, he used the expression "we know—knew all the time, was made after Edison's invention, and the same can be said of 1, 2 and 3."

The planer was equally suspicious. Goebel had claimed that it was made in 1872; their witness says he made it in 1883.

Complaint was made that defendants' counsel had prevented the complainant from gaining the information desired by objecting constantly to questions asked in the taking of depositions.

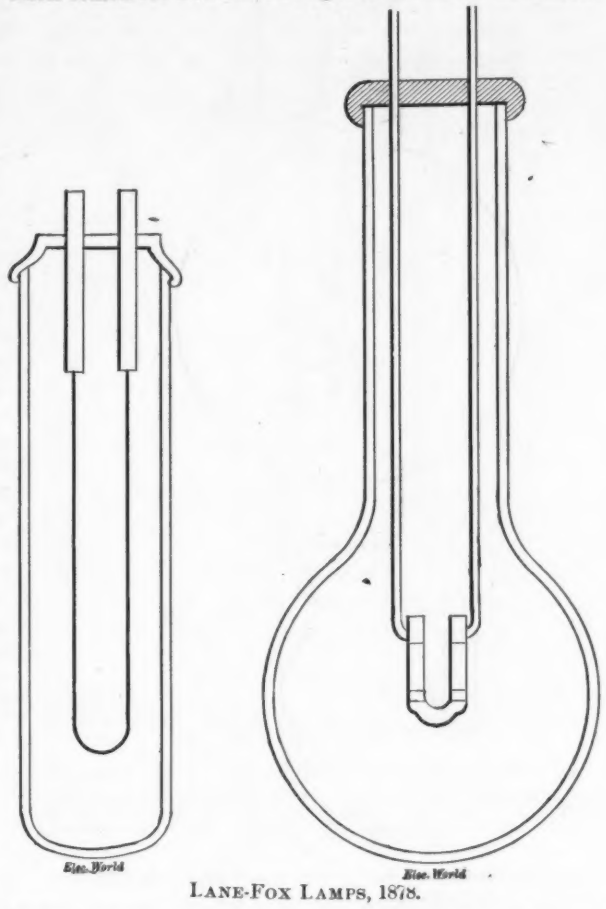
Mr. Witter here spoke up as follows: "If there is any reason why an affidavit or part of affidavit be suppressed by cause of unfairness, he would like to hear it now."

The speaker then reviewed the litigation involving the Goebel defense; rehearsed the Kuhlenkamp story, and expressed the belief that that affidavit alone should have won the case for the complainant. Kuhlenkamp's character had been attacked by the defendant. It was, however, established by the complainant, but so late that Judge Hallett did not consider the evidence at all. Believed that they were stronger in St. Louis than in Boston, but that Judge Hallett had taken an erroneous view of the law; that while he saw the case the same as did Judge Colt, his idea of the law was so different that his decision was opposite.

Mr. Dyer maintained that to raise the question of non-infringement is to prove that the present lamp does not involve features already adjudicated. "We have nothing to do with any new interpretation of the patent," he said; "we are dealing only with adjudicated things, and it makes no difference if a subsequent court should rule that the patent is more limited than it has heretofore been."

He claimed that Henry Goebel, Jr., made lamps 1, 2 and 3, for he had said so, and was supported in this by the purchase of the tubing, by the lamps themselves, by the fact that they were cracked, which glass-blowers say must have occurred within a few hours of the time they were made.

Henry Goebel, Jr., says they were not cracked when he started out for Mr. Bull's office. In the case of No. 4, the defendant's counsel in the Beacon case had proceeded in the belief that it was fraudulent, and admitted they did. They had kept it out of the case until one week after the argument. When our argument made it necessary they introduced it, stating that their suspicion had been removed. Their reason for not introducing it before had b en unsatis-



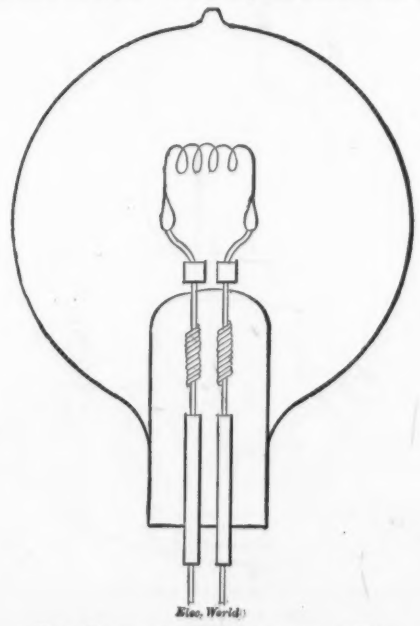
Lane-Fox Lamps, 1878.

factory; it was unsatisfactory to Judge Colt, and he said so. He thought Judge Hallett had overlooked their affidavits about the reproduced lamps, for Upton had showed these lamps were inoperative.

A SENSATIONAL EPISODE.

After the noon recess, Mr. Mitchell arose and stated that he and his *confrères* had had a conference, and, although they deemed that the order by defendants' counsel to witnesses not to answer questions was suspicious, they would not ask to have any of these affidavits suppressed, but they would ask to have Mr. Bull's daybook shown entire to the counsel.

This book had been partly in evidence and partly suppressed. He believed it contained other entries which would throw an entirely new light on some of Mr. Buil's testimony which it was desired by the defence to suppress. Turning to Mr. Witter, he said, "I want to know if you will let me see that book"; to which Mr. Witter replied, "If you will sit down I will tell you what I'll do," and then went on to say: "The gist of complainants' attack is that lamps 1, 2 and 3 were made by Henry Goebel, Jr., in September, 1892. Mr. Bull, then counsel for the Westinghouse company, happened to have noted in his professional daybook the entries of what he did. Two years before 1892 Mr. Bull saw those lamps, and described and sketched them under the date of 1892. The lamp sketches were mac e No-



Tar Putty Lamp, October, 1879.

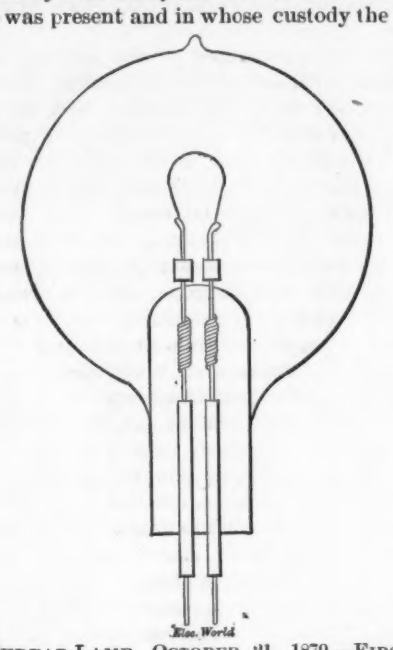
vember, 1890. The defendant did not put them in evidence—the complainants put them in. Their game was delay; they spent the whole night, until 3 A. M., with the sole object of getting the Westinghouse company to sell themselves. Your Honor will find that the fraud and bribery lies with them. Your Honor can have the book, but these people come in with unclean hands—they shall not see it. The Westinghouse company has already been in-

jured by what the public already know of that book; these people spent the whole night trying not to get the truth, but to show up the Westinghouse company."

Mr. Mitchell: "What I want to know is, are you willing that we should see that book?"

Mr. Witter: "Whatever the Court decides I will agree to, but I am not willing that you should see that book. The question was, Were lamps 1, 2 and 3 made in 1892 or did they exist before? If your Honor will find anything in that book about the date, we are perfectly willing to let them see it."

It was finally ordered by the Court that Mr. Bull's brother, who was present and in whose custody the book was,



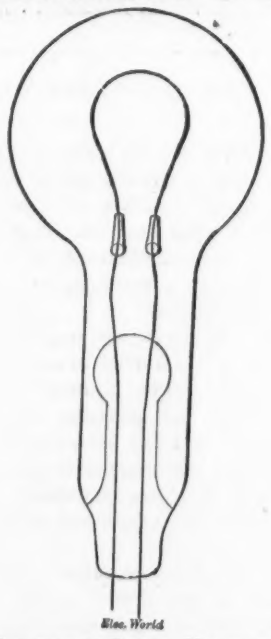
COTTON THREAD LAMP, OCTOBER 21, 1879.—FIRST CARBON FILAMENT LAMP WITH WHICH EDISON MADE DISCOVERY OF DISINTEGRATION OF CARBON.

should copy everything in the book relating to the Goebel matter and submit it to the counsel. If, however, there should be anything concerning the hearing of which he was doubtful or anything which he thought it would be unprofessional to make public, he was to submit it to the Court.

Mr. Dyer then went into the history of the evolution of the incandescent lamp, showing a large number of drawings of early forms, and describing them in detail, and explaining by hydraulic analogy the meaning of series and multiple arc distribution. He also showed the technical difficulties, all of which had to be mastered before a practical lamp could be made, and adverted on the improbability—impossibility—of Goebel's having done what was claimed, citing Judge Wallace's criticism of the Drawbaugh case as to the incredibility of the claim of Drawbaugh to having made such a discovery without any experiment leading up to it.

The Drawbaugh telephone case was cited, and Mr. Dyer said the Drawbaugh defense in the telephone cases, both in the lower court before Judge Wallace and in the Supreme Court, was defeated mainly upon the theory that if Drawbaugh himself was proved unworthy of belief, and if his acts relative to his alleged invention were inconsistent with the claims advanced in his behalf, his story would not be believed, notwithstanding the vast number of corroborating witnesses. He then proceeded to show that Henry Goebel, upon whom the defense depended, was unreliable; Geobel had falsified in this case, not once only, but many times. His dealings with other men in relation to his inventions show him to be dishonest and untruthful.

First he gave false testimony as to the use of cements.



PAPER HORSESHOE LAMP, NOVEMBER, 1879.

In the Beacon case the lamps 1, 2 and 3 were criticised on the ground that iron and copper were unsuitable for leading-in wires on account of their different coefficients of expansion from glass. Goebel, to refute these charges, attempted to make lamps with iron wires and testified that he covered the surface of the iron wires with borax—with liquid rubber, etc.—forgetting that in his first affidavit he stated that "the metallic wires were fused directly into the glass, no cement or other substance being used."

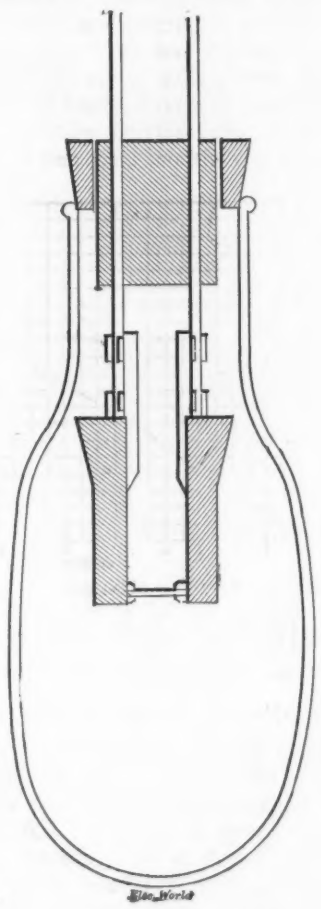
He showed how lamp No. 4 was introduced after the arguments to meet the objections to lamps Nos. 1, 2 and 3.

A point made here by Mr. Dyer was an imputation that the claim of defendants that they had not had time to investigate lamp No. 4, and that for this reason they had not introduced the lamp before, was not true, for Mr. Allan Kenyon swore that Henry Goebel, Jr., had been employed in October, 1892, and it had also been proved that Mr. Bull had No. 4 about the same time as Nos. 1, 2 and 3; yet counsel now say they only had No. 4 a few days before.

He spoke of Pope's reason for suspecting No. 4 as ingenious, but as a matter of fact he had no reason to expect to find the copper wire amalgamated, for, as Dr. Boehm had testified, it was not likely to amalgamate, and if it did, all the mercury would have been driven off in the process of sealing off, and the copper would have become oxidized. Pope never thought so, but it was the best reason he could think of for withholding the lamp.

Goebel states that No. 4, like the others, was exhausted by the Torrecellian method. Mr. Dyer did not think it was, but believed that it was exhausted on an improved pump. It has too high a vacuum, according to Thomson's affidavit, to have been exhausted in this way. Another reason was that it contained no mercury. Both sides to the suit had had lamps made by the Torricillian method for various purposes, and every one of these had a globule of mercury in it, and it was impossible to avoid this; therefore No. 4 was not made as Goebel said it was. Boehm had testified that No. 4 was made by an expert glassblower, but according to Wm. Goebel, his father was a bungler; he therefore could not have blown that lamp.

Another fact was worthy of notice, viz., that when Goebel was put in the Beacon factory to make lamps such as he claimed to have made he did not make a single lamp by the method of construction employed in No. 4, with the



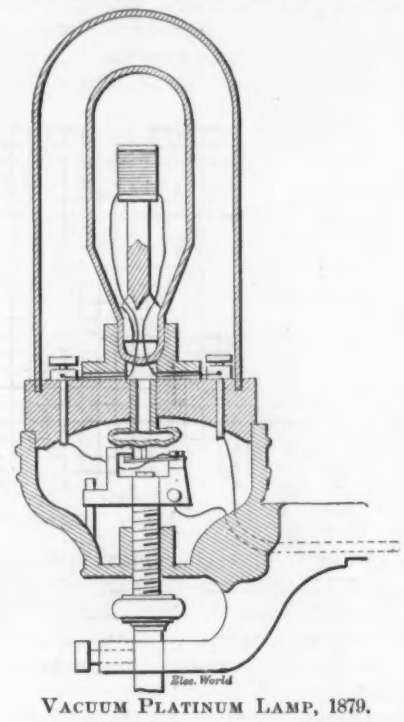
FARMER'S LAMP.

seal at the side, which he had testified was the method he had always employed. The arch in the filament of No. 4, too, was so perfect that it must have been bent around a metal rod before carbonizing, and yet Goebel makes no mention of this fact. Lamp No. 4 was made by Heger, the expert lamp-blower.

Mr. Dyer held that the showing of the falsity of the exhibits was a very serious matter to the defendants. They (the defendants) had said that it would be denied, but they had never subpœnaed Henry Goebel, Jr., nor had they put Henry Goebel, Sr., on the stand. These were very suspicious facts. He then discussed Bull's testimony, which had been used in the attempted denial, and showed its insufficiency. As evidence that Bull had not made his sketch from the lamps themselves, but from descriptions, he stated that in Bull's sketches of the meat-saw lamp he does not put in the bridge, whereas the lamp itself had a bridge. Another conclusive point was this: In Bull's sketch of No. 1 a little circle appears at the apex. He says that the tip was broken off when he first saw the lamp in Henry Goebel's possession, and this circle represents this fracture. Henry Goebel says it was broken off in delivering to Bull in 1892. Mrs. Opry also says that when in her possession the lamps were not broken, and Mr. Opry says the same. This tip could not, therefore, have been broken off when Bull claims he saw the lamps two years before.

The planers were not mentioned at first in the Beacon case, but were only introduced when it was suggested that they would be valuable evidence. Perkins, an infringer, testifies to having seen them, but *not* before the Edison patent. Goebel told defendants he had no recollection of having cast the base of planer No. 6. Later he says that he did. Heger says they used only a knife to cut the bamboo when he first went there, but as this was too slow they made tool No. 6. Mrs. Opry says she saw her sister Annie use those planers upstairs in 1881, which is equivalent to saying that she did not see them before, yet Goebel testifies that he used them repeatedly prior to 1871. The intended effect of this is to overcome Korwan's date of 1883, but the fact is it discredits her father's testimony.

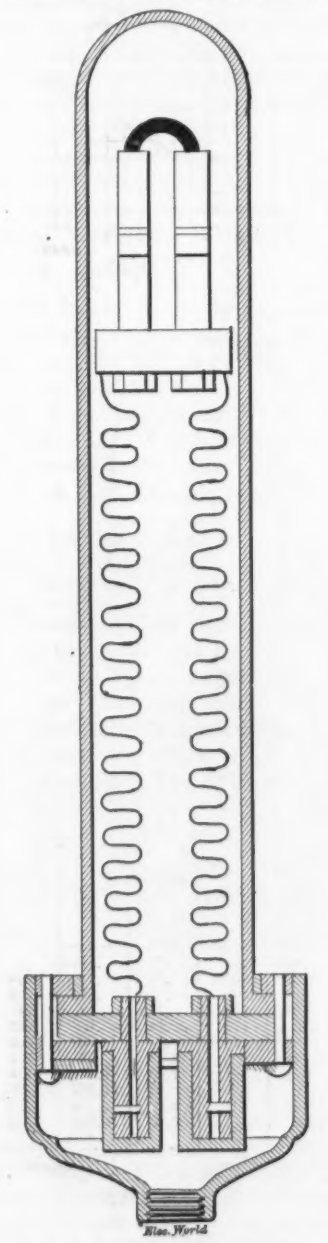
Henry Goebel testifies that he knew nothing about Edison's work. Wm. Goebel, the new California witness, states that his father took certain papers which did tell all about it. Mrs. Opry says she saw no pump until she was



VACUUM PLATINUM LAMP, 1879.

married, in 1881. Wm. Goebel says the first pump he saw was in the American factory, and that subsequently his father had one made like it.

The Kuhlenkamp incident was discussed at length. Goebel applied for patents on some minor details of a lamp. These were rejected because of Edison's patent. Goebel did not fight, but amended his application so as not to in-



SAWYER-MAN LAMP, 1885.

terfere—thus virtually admitting Edison's claim. The patent was for a spiral form of leading-in wire. It was filed January, 1882. Lamps 1, 2 and 3 had this feature. Yet Goebel claims he used this in 1854. He was therefore in a splendid position to show that he had anticipated Edison, if this were true. If Goebel had the spiral when he claims he did, he was practicing fraud upon the government when he applied for a patent in 1882.

As to the claim of defendants that complainants had tried to bribe Henry Goebel, Jr., and other witnesses, the testimony on that point was absolutely trivial. Henry Goebel, Jr., had worked for defendants for months after they claimed that he was approached by Hoffman. How, therefore, was this consistent with their claim?

Mr. Dyer closed with the statement that without the original exhibits the defendants had no case; that lamp No. 9 was exactly like No. 4, and that was proved to be a fraud. No. 9, therefore, must fall with it. It is also very like No. 5, which is admitted to be later than Edison's patent.

Barker, Howells and Upton's testimony was cited to show that Goebel's reproduced lamps were inoperative. Defendants had had an opportunity to reply to these tests, but had not done so. The Vander Weyde affidavits were brought up to show that defendants' counsel had caused him and others to appear to say what they had not said. He did not accuse the counsel themselves with this, but accused them of having employed Henry Goebel, Jr., to do this and other dirty work. The theory was then advanced that the lights which so many witnesses claimed to have seen were not incandescent electric lights at all, but were magnesium ribbons, Geissler tubes, or arc incandescent lamps. In proof of this supposition, Wm. Goebel, in his California deposition, speaks of his father's having experimented constantly with such lamps.

Thus ended by far the strongest presentation of the complainants' case that has thus far been made. In this report, which, lengthy as it is, is the merest synopsis, Mr. Dyer has stamped himself as a great lawyer. The defense admit that it was a most admirable effort, and one that could not be improved upon. Mr. Witter followed for the defense.

(To be concluded next week.)

Electric Lamp Litigation.

Judge Lacombe, of the United States Circuit Court, on July 1 granted injunctions to the Edison Electric Illuminating Company, of New York, against the Holland House and the Imperial Hotel, prohibiting them from using incandescent electric lamps infringing the Edison patent, under which the Edison Electric Illuminating Company, of New York, is sole licensee in the city of New York. The hotels in question were given ten days to arrange for other means of illumination.

The proprietor of the Imperial Hotel states that Edison lamps have been substituted for the others in use, and that the injunction will not be contested.

An Efficiency Test of a Small Motor.

BY J. H. HOLT.

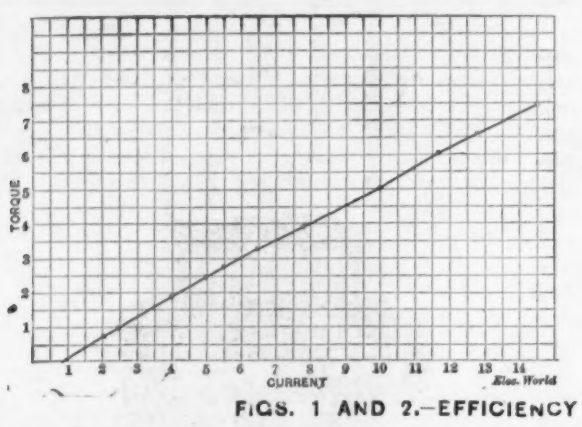
The following test of a 1-h. p. (rated) motor was made in the Laboratory of Electrical Engineering at the Alabama Polytechnic Institute. Of course the table and curves embody nearly all of the results, but I will discuss briefly some of the circumstances attending the test.

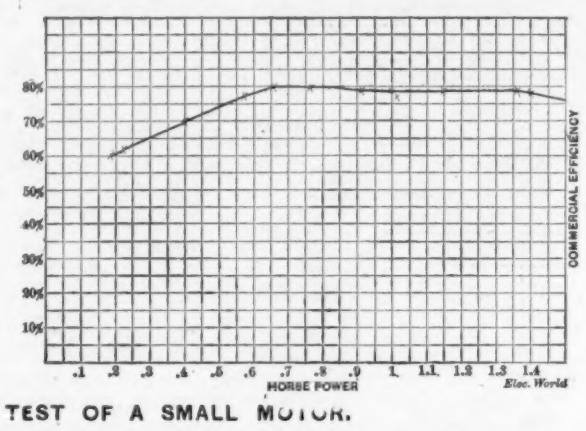
The motor in question was a 1-h. p., 110-volt, 8.8-ampere machine, and stamped to run at 1,150 revolutions per minute. It was purchased by the college in November, 1891, and while the same in all outward appearances, it is not of the very latest type. The Crocker-Wheeler company, the manufacturers of the motor, claim that the machine produced by them now uses only 8 amperes instead of 8.8, as formerly; also that the field current is about one-half of what it was formerly; they also claim that the speed has been reduced from 1,150 to 1,000 revolutions per minute in this type of machine.

The surroundings were favorable for such work, being carried on in a laboratory thoroughly equipped with the necessary apparatus. The dynamometer used was a Prony's friction brake. A Weston voltmeter indicated the voltage, while an ammeter of the same make measured the current. The speed was indicated by an ordinary speed indicator, and the current gotten from 110-volt constant potential mains. The temperature of the room registered about 75°.

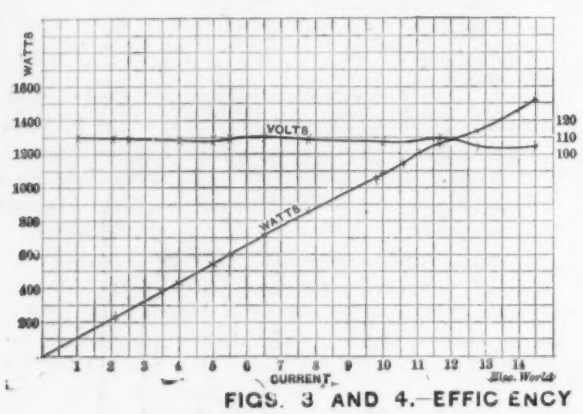
Before starting the motor the resistance of the field and armature was ascertained to be 249.8 and 1.1 ohms respectively. The current was then turned on and the motor was run without load, and the voltage and current noted. The loss due to friction, hysteresis and eddy currents, which is not directly calculable, was found to be 65.3 watts. An extremely small load was then put on, and by the well known formula h. p. $= \frac{2\pi N L P}{33{,}000}$, where N = number of revolutions per minute, L = length of brake arm, and P = the pressure indicated by the scales in pounds, the horse power was found to be only .1816, as shown in the table, and the efficiency 60 per cent. The length of the brake arm could be altered by changing the position of the scales; this done, a slightly greater load was put on, and the results gotten as before. The loads were increased gradually up to the eleventh reading, which is above the machine's capacity, and here they were reversed to check the others.

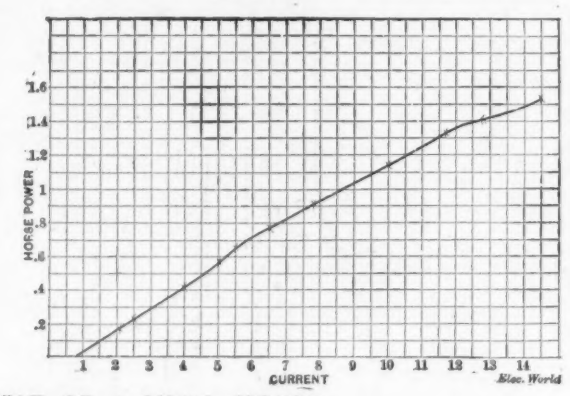
All intermediate values between .1816 and 1.53 h. p. can be readily obtained by referring to the curves. In Fig. 1 is shown a curve platted between current and torque. It shows in what proportion the torque increases with the current. Fig. 2 is a curve between horse power and efficiency, and from this we can tell at what efficiency the machine is working when under various loads. In Fig. 3 are two curves—one between current and watts, and the other between current and volts. These are, of course, to be used in connection with the other curves. Fig. 4 is a curve between horse power and current. The losses which take place in the motor are given under their respective heads in the table. To the results under the head of "Watts Lost in Field and Armature" must be added the watts lost by eddy currents, friction and hysteresis, in order to obtain the total watts actually lost in the machine.





FIGS. 1 AND 2.—EFFICIENCY TEST OF A SMALL MOTOR.





FIGS. 3 AND 4.—EFFICIENCY TEST OF A SMALL MOTOR.

TABLE OF EFFICIENCY—LOSSES, ETC.

N	Amperes.	Volts.	Electric H. P.	Brake H. P.	Efficiency.	Speed R. P. M.	Weight on brake, in pounds.	Length of arm, in feet.	Torque.	Current in fields.	Watts lost in fields.	Current in arm'ture	Watts lost in arm'ture	Total watts supplied	Lost watts in armature and fields.
1	7.06	110	.39	.1816	60%	1272	.438	1.713	.750	.44	48	1.62	2.886	226.6	50.88
2	2.5	109	.36	.3218	61%	1224	.3437	2.773	.953	.436	47.5	2.06	4.66	272.5	52.16
3	4	109	.57	.405	70%	1260	.6875	2.773	1 9	.436	47.5	3.56	13.93	436	61.43
4	5	108	.723	.57	77%	1260	1 438	1.713	2.46	.432	46.6	4.57	22.96	540	69.56
5	5.5	110	.81	.65	80%	1228	1	2.773	2.77	.44	48	5.06	28.1	605	76.1
6	6.5	110.5	.95	.761	80%	1216	1.188	2.773	3.29	.442	48.8	6.06	40.39	718.2	89.19
7	7.8	109	1.15	.91	79%	1220	1.413	2.773	3.92	.436	47.5	7.36	59.57	860.2	107.7
8	10	107	1.45	1.14	78%	1160	2.938	1.713	5.03	.428	45.8	9 57	100.7	1070	146.5
9	11.7	109	1.72	1.357	79%	1196	2.188	2.773	6.06	.435	47.5	11.26	139.4	1275.3	186.9
10	12.8	104	1.8	1.409	78%	1120	2.385	2.773	6.61	.416	43.2	12.38	153.3	1331.2	196.5
11	14.5	105.5	2.05	1.538	75%	1084	2.688	2.773	7.45	'422	44.5	14.07	197 9	1529.7	242.4

NEW BOOK.

LEÇONS SUR L'ELECTRICITÉ PROFESSÉE À L'INSTITUT ÉLECTROTECHNIQUE MONTEFIORE, ANNEXÉ À L'UNIVERSITÉ DE LIÉGE. Par Eric Gerard, Directeur de cet Institut. Deux volumes. Troisième édition, refondue et complétée. Paris: Gauthier-Villars et Fils. Liége: Leon de Thier. 644 + 632 pages, 524 illustrations. Price $5.00.

As a beautifully clear and compendious treatise for students on the theories and applications of electricity, and as a résumé for engineers of electrical theories having a practical bearing, this work, it may be safely said, has no rival in any language.

The logical methods of the author, and his faculty of lucid expression and illustration have simplified the subject in a remarkable manner; and as the scope of the work is exhaustive, the entire range of practical electrical science may be said to be definitely placed through it within the reach of the student and engineer of but ordinary mathematical attainments. The service which the author has done for electrical science is similar to that of Ganot years ago for general physical science, and, earlier, of Legendre and Bourdon, for mathematics, which previously had been in a similarly unsatisfactory and disconnected state, viewed from the standpoint of the student.

The first volume is on units, theory of electricity and magnetism, electrical measurements, and the theory and construction of generators and transformers. A section is devoted to an extremely clear exposition of the modern theories on the propagation of currents.

The second volume is devoted to practical applications and deals with the distribution of electricity, and aerial, underground and submarine conductors, motors, transmission and distribution of electrical power, electric traction, telegraphy, telephony, electric lighting and electro-metallurgy. In the section on conductors, practical methods of testing are given, and in the latter part of the book the calculation of networks is thoroughly treated as well as other questions relating to the laying down of plans for a lighting system. The section on multiphase motors is particularly clear and thorough, and that descriptive of central stations contains much information of direct practical value.

The fact that a third edition of such an extensive work has been required within two years is evidence that it fills a distinct need, and proves that the author's idea of a treatise equally removed from the speculations of pure theory and from simple descriptions or a catalogue of apparatus was well founded.

LITERARY NOTE.

The first number of the "Physical Review" has appeared, and both in appearance and in the character of its articles is a credit to its sponsor, Cornell University, and to its editors, Professors Nichols and Merritt. The purpose of this new scientific periodical, which will be published bi-monthly by Macmillan & Co. for Cornell University, is to afford a channel for the publication of the results of research, to discuss current topics of special interest to the student of physics, and to reproduce in full or in part important foreign memoirs not easily accessible in the original to American readers. Papers read before local scientific bodies will also be published under the conditions that the paper must be communicated by the author to the editors in manuscript previous to its appearance in printed form in the transactions or proceedings of the society in question, or elsewhere.

Among the contents of the first number are three articles and several notes on electrical subjects, and reviews of four recent electrical books of importance.

The Ford-Washburn Storage Cell.

Profs. John W. Langley and Chas. T. Mabery have recently made an exhaustive and elaborate report on the Ford-Washburn storage cell (described in The Electrical World, July 30, 1892), in which its electrical, chemical and mechanical properties are thoroughly considered. As a result of the tests the following conclusions are given:

1. The cells have not appreciably changed their internal resistance during two months' constant use, when tested under similar conditions.

2. Vibration and shaking, continued for an aggregate of 422 hours, did not increase the internal resistance.

3. The ampere capacity of the cells is 150 hours when tested to exhaustion, and when drawn down to one volt a cell holds 133 ampere-hours at a 10-ampere rate of discharge.

4. The practical working limits of voltage are from two volts to one volt.

5. The cells do not show any marked tendency to "sulphating," and their internal resistance is not permanently raised thereby.

6. During the interval covered by this report neither large rates of charging and discharging nor a prolonged course of vibration, imitating that of a street car, produces any measural e deterioration of plates. In this respect the Ford-Washburn cell was in marked contrast to a cell of the grid type used for comparison.

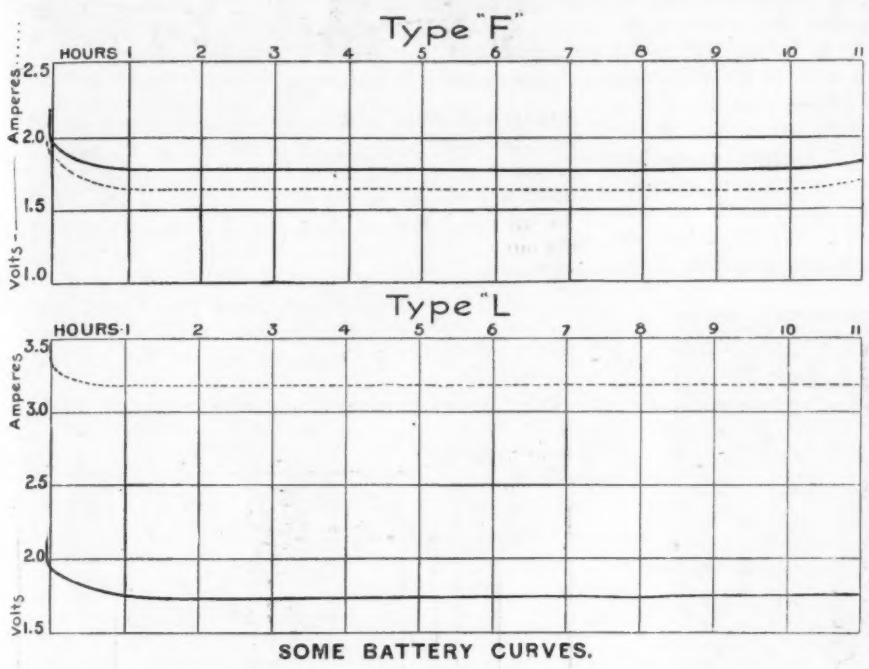
7. The ampere efficiency varied from 73 to 86 per cent. and the energy efficiency from 55 to 72 per cent.

8. The electrical and mechanical hard treatment to which the cells were subjected in their hands was excessive, and indicates that they have the qualities to withstand rough usage in practice, for, from the results given above, it is apparent that no measurable impairment of them was developed by exceptionally severe electrical and mechanical usage during two months; therefore, the point when the life of the cells would be terminated is indefinitely distant in the future.

Some Battery Curves.

Volt and ampere curves from closed circuit primary batteries are so seldom printed that it is like coming face to face with the mysteries to encounter them.

Herewith we illustrate two readings taken from different sizes of a carbon cup cell, which has attained



SOME BATTERY CURVES.

prominence within the last two years by reason of the moderate tone assumed by the makers in their claims. The results appended are not remarkable as to current discharge, but show commendable results in that the E. M. F. is practically maintained after the first hour. The object has evidently been to produce a cell that would give moderate ampere discharges at a high electromotive force over considerable spaces of time by reason of the density of the carbon diaphragm, and the accompanying diagrams taken from cells already partially discharged would seem to indicate the attainment of this end.

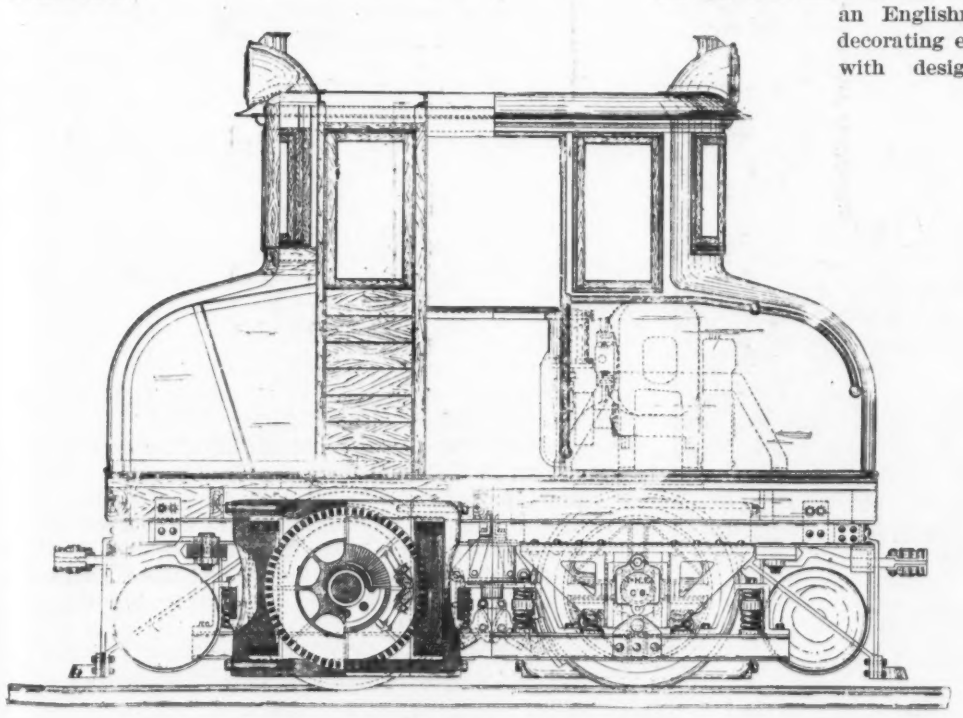
The curves were obtained from two cells of the Kolon primary battery, for which we are indebted to the manufacturers.

Electric Light Glassware.

It is curious to note the changes in electric light glassware since its first introduction in commercial form. Mr. Sheehan, of the Edison company, was probably the first to see the necessity of using a colored or tinted glass for the purpose of toning the glaring effect of the light on the human eye; his idea then was to give the light a yellowish tinge, which idea still holds good with the majority of the consumers of electric light. Shades of this character were first used at one of the large public balls or carnivals. The production of "ivory" glass, first made by F. Thills & Co., of Brooklyn (at the suggestion of Mr. Sheehan), served to develop the "fire opalescent" glass, first produced by A. & R. Cochran, Glasgow, Scotland, in the early stages of the incandescent electric light, and no other glass was considered for a while suitable; being made in very limited quantities, however, it was quite expensive. It soon became a scramble among manufacturers and importers to produce a form and color of glass most desirable for the purpose in view.

The firm of L. D. Hatton & Co., West Fourth and Greene streets, New York, were among the first in this field, and introduced metallic etched goods which were entirely new, both in form and style of work, and had a large run, but were expensive, and domestic manufacturers soon succeeded in largely replacing them with cheap imitations, and under various names, such as pearl, silver and satin etched, etc. Next came the stalactite, which one of the leading designers of this country, or in the world, in gas and electric fixtures, at once introduced into his work; with such backing it did not take long to introduce the stalactite, which, in various forms and under as many names, is still very popular. Among the next novelties introduced by this firm were the flower shades, first called English roses. Failing to have these produced at the Cochran works in Glasgow on account of the cost, they were taken to Bohemia, where, selecting the factory best equipped for their purpose, the manufacturer, a rich nobleman, was induced by being given a very large order, to make the goods; the price charged was high, but the goods were very satisfactory. This style grew rapidly in popularity until roses of every conceivable form and color were brought out. Next were introduced fans, stars, pansies, morning glories, and a variety of natural effects that obtained a fair share of the public taste, but which, like most artistic and expensive shades, were soon more or less handicaped by a perfect deluge of cheap stuff, until the market, even at this day, is fairly flooded with glass that no manufacturer with any knowledge of color or effect would produce. The better class of manufacturers in this country are now trying to produce a more artistic article than they have heretofore done, but the work of foreign factories has not yet been equaled in America.

An ingenious machine has recently been invented by an Englishman of Manchester for decorating electric and gas glassware with designs. This can be used for designs of the most intricate character, and the work is not of the nature of reproductions. The machine at present, like most foreign machinery, is heavy and expensive, so that a field is presented here for the American inventor to exploit and produce a machine cheaper and lighter, and one that, at the same time, will turn out work more quickly.



SECTION OF THE LOCOMOTIVE.

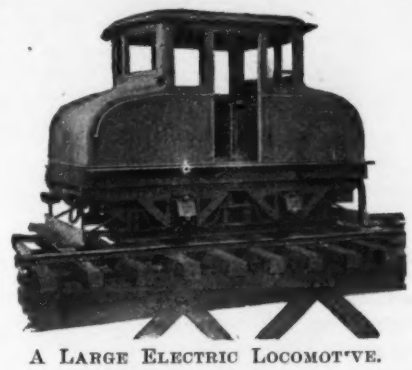
A Large Electric Locomotive.

The first electric locomotive of any considerable size in the United States, and the first practically operative high speed electric locomotive in the world, adapted to the steam railroad, has recently been completed at the Lynn works of the General Electric Company, and will shortly be exhibited at the World's Fair. Its completion marks a distinct advance in electrical development.

It is a 30-ton locomotive, designed for a normal speed of 30 miles an hour, primarily intended for operation on elevated railways, and for passenger and light freight traffic on smaller steam roads. It is of compact construction, solidly and substantially built, and runs on four 44-inch wheels. Its dimensions are 16 feet 6 inches long, 11 feet 6 inches high, 8 feet 4 inches broad, having its drawbars 2 feet 6 inches from top of rail—the Manhattan Elevated Railroad standard height. The drawbar pull is calculated at 12,000 pounds.

The propelling power is furnished by two electric motors of special design and construction, each axle being provided with one motor. The motors are gearless, and are supported on spiral springs resting on the side frames of the locomotive truck. This method of suspension leaves the wheels free to adjust themselves to the irregularities of the roadbed, and consequently the wear to both tracks and motors is diminished.

The motor fields consist of massive iron castings, to which the hollow field spools are bolted. The armatures are of the ironclad type, having each separate winding embedded in a mica-lined slot cut into the curved surface of the laminated iron armature body. The axles of the

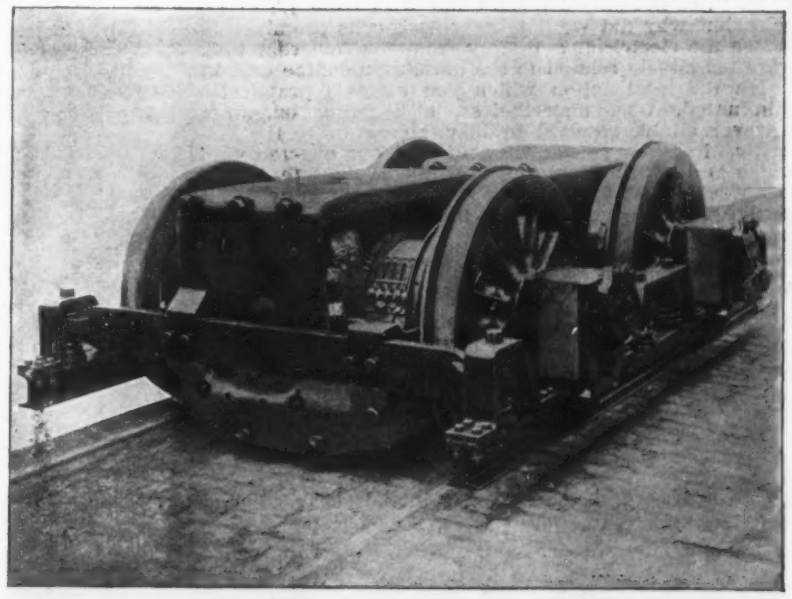


A LARGE ELECTRIC LOCOMOTIVE.

locomotive pass through the hollow shafts on which the armatures are mounted. Those shafts rest in bearings of the motor frame, and are connected to the axles by universal couplings, which allow of freedom of motion in all directions. The commutators are of massive construction, and there are four sets of brushes to each commutator.

The motors are controlled by means of a series parallel controller, set up in the interior of the cab. Under test it is found that the series parallel controller allows of a more gradual and easier starting of the electric motor, and the speed can be more delicately and instantaneously controlled than in the case of the steam locomotive.

The truck, suspended from the journal boxes, is constructed of heavy I beams, and forms the foundation for the locomotive cab, of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motorman's movements, and it



MOTOR MOUNTED ON TRUCK.

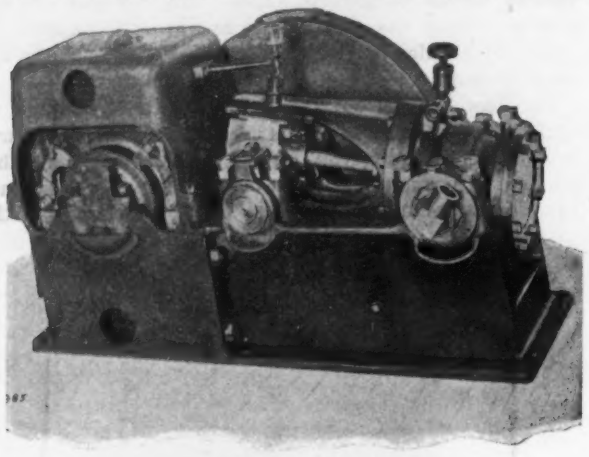
affords him considerably better protection than that usually vouchsafed the steam locomotive engineer.

The air for the brake is supplied by a special electrical air compressor, which also operates the whistles. This air pump has an oscillating cylinder of 6 inches diameter, with a 6-inch stroke, supplying 6,000 cubic inches of air per minute at 70 pounds pressure. The motor is similar to the N. W. P. 2½ in general appearance, but is wound for higher speed. The normal speed of the armature shaft is 675 revolutions, and of the crank shaft of the pump 110 revolutions. The dimensions of the air compressor are: Length, 41 inches; width, 16½ inches; height, 25 inches. The pump motor is controlled by a special rheostat. This, by an intermediary device, is automatically regulated by the air pressure.

This locomotive has been designed for a normal speed exceeding 30 miles per hour. The use of these

locomotives over very long distances is at present limited only by the cost of long lines of electric feeders, and until the problem offered by this condition is solved restriction of its employment must necessarily exist. But for places comparatively near each other, and where traffic is dense, the denser the better, the electric locomotive is peculiarly adapted, for here all the advantages of electric propulsion are available, unhampered by the extreme expense involved in long feeder lines.

The evolution of the use of the electric locomotive will probably follow along the lines dictated by expediency and favoring conditions. At first they will probably be used in elevated railroad service, and in New York, Brooklyn and Chicago alone their advent will be hailed with a feeling of deep gratitude. They



THE MOTOR.

will then probably be adopted as feeders to the trunk lines, both for freight and passenger traffic, and to operate short suburban lines, where a rapid, efficient service is requisite. Their peculiar fitness for switching purposes will advance their use another step, and then slowly, as the different problems presented are overcome, they will invade the province of the trunk line steam loomotive, and the millennium of railroad travel will be within the realities of life.

Aluminium-Iodine Portable Testing Set.

In reference to the descriptive article on this subject which appeared in a recent number of The Electrical World we have received a communication from the Chloride of Silver Dry Cell Battery Company, of Baltimore, Md., from which the following is an extract:

"We notice in your issue of July 1 an article entitled 'The Aluminium-Iodine Portable Testing Set,' manufactured by Queen & Co., of Philadelphia, or, more properly speaking, a comparison of E. M. F. between the aluminium-iodine and the chloride of silver cell. In reply to this article we desire to say that there are several points which need correction, and which the author no doubt failed to recognize in his composition.

"In the first place, our present form of chloride of silver dry cell has an E. M. F. of about one volt.

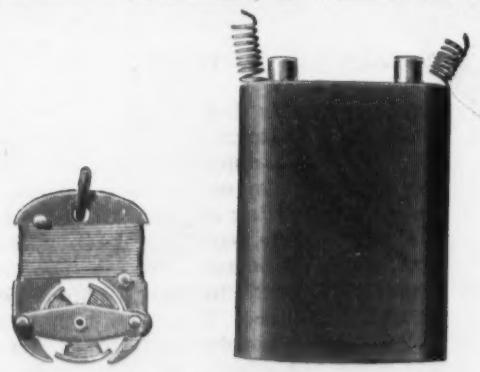
"Secondly, there is absolutely no local action, so that there is not only practically, but positively, no waste of the elements while not in use.

"Thirdly, a chloride of silver cell can be made with an E. M. F. of not only 1.4 volts, but with from 1.5 to 1.6 volts, but why did we not bring such cells prominently before the electrician? Simply from the fact that they were too closely related to the aluminium-iodine cell, in which the local action which you state is practically eliminated, was, nevertheless, still going on, and, however slight, resulted in inevitable ruin to the elements. For this reason we preferred our one-volt cell, which is devoid not only of any injurious waste, but of any waste whatever, to a cell of 1.5 volts in which a local action of the slightest nature would invariably mean destruction."

The Chloride of Silver Dry Cell Battery Company further states that they are not in a position to go into such details as they desire, as they have been unable to procure an aluminium-iodine cell in order to make the comparison between that and the chloride of silver dry cell of their own manufacture.

The Little Jewel.

We illustrate a decided novelty in the electric line, a real electric motor, rated at 500 flea power, to be worn as a charm on a watch chain; and which is run from a



THE LITTLE JEWEL.

small vest pocket chloride of silver sealed battery. The electric motor is finished in gold and silver, and can be run continuously by the current from the battery. Both battery and motor are shown full size and are manufactured by John R. Kennedy, San Bernardino, Cal.

The New Brush Arc Lamp.

The first brush lamp was made nearly fifteen years ago, and since then the same type of lamp has been in continuous use, furnishing a large proportion of the 300,000 arc lamps now burning nightly in America. While this type of lamp still gives eminent satisfaction and will continue to be manufactured, the Brush company has recently placed another lamp on the market which embodies several improvements suggested by long experience. The most important of these is the feed clutch, which obviates all difficulty from dirty and worn rods, and, indeed, would work with a rod having a screw thread cut in its surface.

The clutch mechanism is shown in Figs. 3, 4 and 5, and is supported on the arm C E (Fig. 3), the clutch lever, B, pivoting in this arm, as shown at F, Fig. 4.

Fig. 4 shows the clutch gripping the rod tightly. The armature arm F may move up and down and will carry the rod with it until the clutch trip E comes in contact with the bottom plate G. As soon as this occurs, however, the downward movement of D is arrested, while F continues to descend, carrying with it B. Referring to Fig. 5, which is another view of the shoe, C, H is a slotted hole in C made wider at the bottom than at the top. b is a rivet which runs through B and C at the top or narrow part of H. d is a rivet which runs through D, B and C at the lower or wide part of H. At this point in H there is a lateral play of 1-16 of an inch, in order that the pivot d may not become clogged. Now,

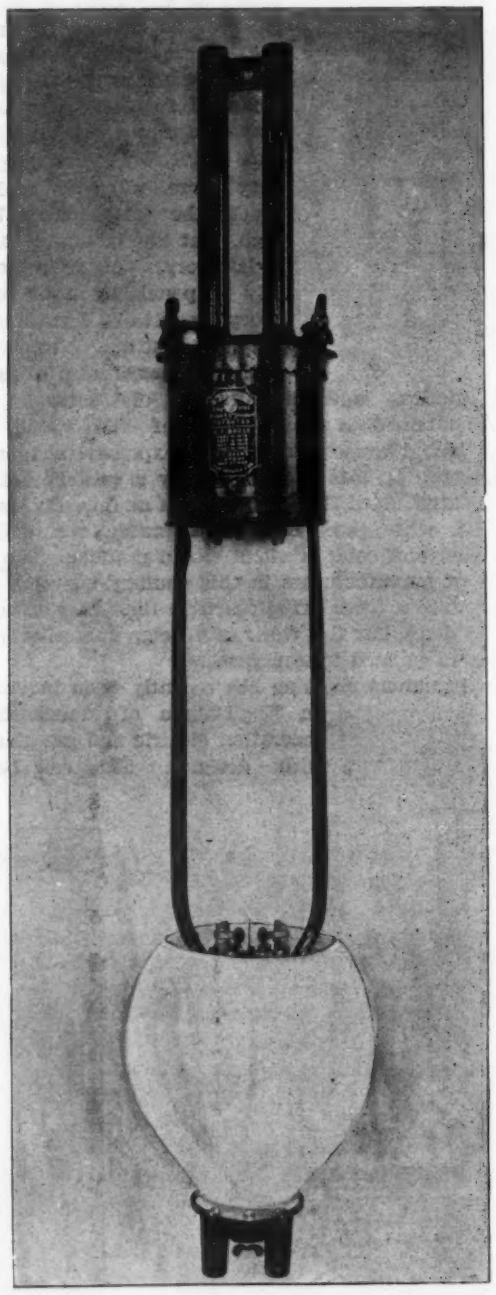


FIG. 1.

when E strikes G so as to hold D stationary, F continues downward and swings C outward away from the rod A just so far as there is lateral play at its pivot d, which is 1-16 of an inch. This allows the rod A to descend by its own gravity, thus causing the carbons to approach each other. The near approach of the positive and negative carbons by decreasing the electrical resistance renews the strength of the spool magnets, and instantly F is drawn upward, which causes C to renew its hold on A, but at a point a little higher up. This operation is then renewed and continues until the carbons are consumed. The new lamp does not release the rod gradually, but allows it to drop suddenly; it has been found, it is claimed, that a sudden feed with the proper mechanism maintains a much quieter and steadier arc, and with closer regulation, than is possible with a "sneak feed" lamp.

Fig. 3 shows the regulating mechanism; F is an armature drawn up or let down between two magnets, the other one being in line with the one shown. G is an air dash pot in which a closely-fitting piston attached to K works. C is the pivot of the lever system, A the carbon rod and RT—J the cut-out which operates when a carbon burns out or is broken.

Fig. 2 shows the electrical connections in which the cut-out, etc., are lettered the same as in the previous figures. Leaving out of consideration at present the auxiliary cut-out KY, we will suppose the lamp with no current and the cut-out J closed. When current is turned on it enters at P^1, where it divides, part going directly to the carbon holder and part to the controlling mechanism through the resistance j. The object of the resistance j is to permit the lamp to be regulated for the

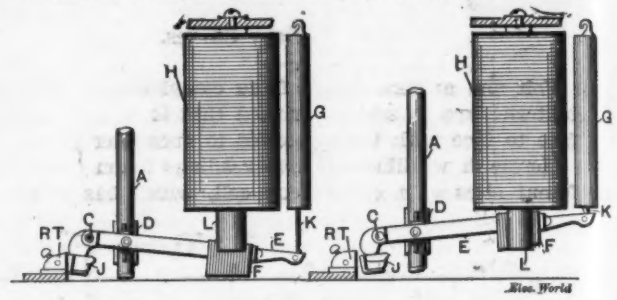


FIG. 3.

voltage for which it is to be used; otherwise all of the current could pass direct to P. From P the current passes to a, or the lamp cut-out, which we will suppose open, and thence by b c to T; at T the current divides, but in order that all shall not pass through the closed cut-out there is a resistance V which enables part of the current to pass through the thick wire of the magnet, which energizes it and raises the clutch; the cut-out is opened (which throws out V), the arc struck and all the current now passes through W into the carbon rod.

A small wire f is also wound on the magnets and is

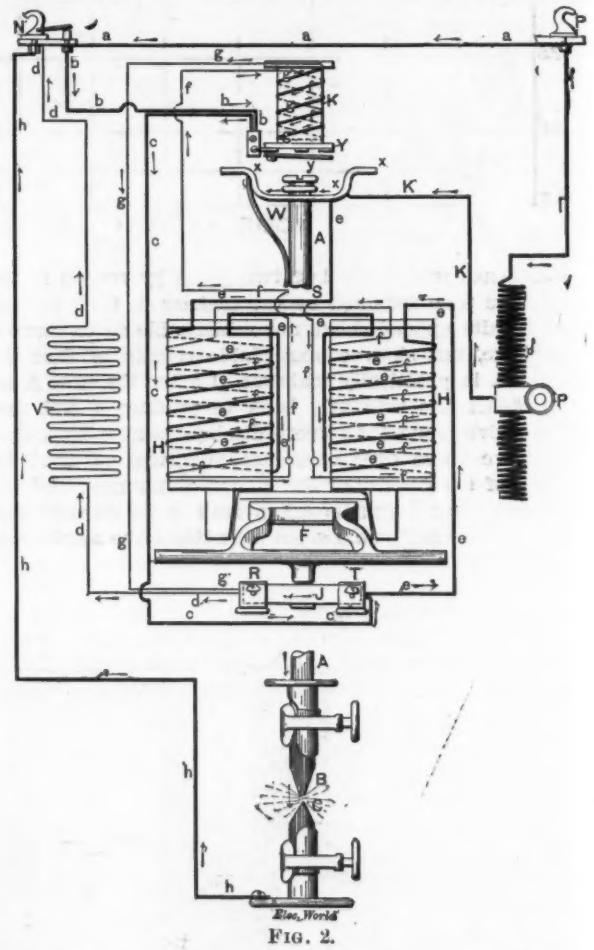


FIG. 2.

tapped in at S, proceeds to K, thence by K to R and thence through V to the negative terminal N; it is thus in shunt with the arc, and as the latter lengthens the current in the shunt increases. The shunt, however, is wound opposite in direction to the heavy wire on the magnet, so that as the current in it increases it decreases the effect of the main current, the magnet is weakened, the armature lowered and the carbon fed so as to decrease the length of the arc; when the shunt weakens, the power of the magnet increases and the arc is regulated again to its proper length.

Should one of the carbons become broken all of the

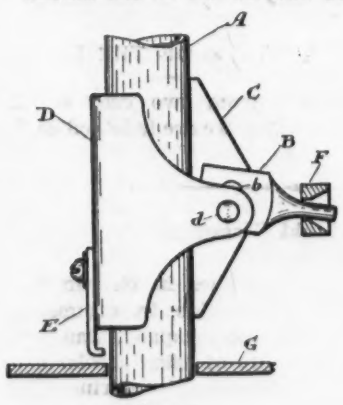


FIG. 4.

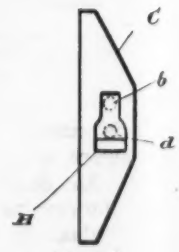


FIG. 5.

current would have to pass through the shunt, and, although the main magnet would at once act, through the lever, on the cut-out, the small shunt wire might be damaged before the latter would close, and to obviate this

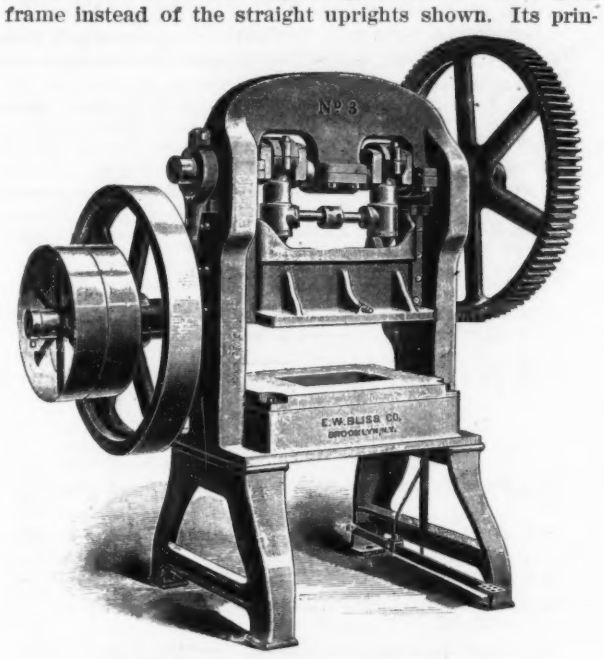
danger the auxiliary cut-out K is used. The shunt current passes around this, and when it gets above a certain strength the armature y is lifted; this makes a contact at Y, and all of the current passes through a heavy winding, g, which continues to hold up y, and thence to R and out of the lamp until the cut-out T is thrown in, when the current passes through T—R out of the lamp.

Fig. 1 shows the lamp complete with the globe dropped down, which latter operation may be accomplished in a few seconds by simply loosening a thumb nut under the globe holder. A rod running up the inside between the lower carbon holders acts as a guide and an adjustable nut on the end of the same as a stop.

Bliss Double Crank Press.

The E. W. Bliss Company, 17 Adams street, Brooklyn, have modified their No. 3 double crank press, the new form of which we illustrate, showing the new design of the frame, which has also been considerably strengthened, and the new method of connecting the two pitmans so as to enable the operator to quickly raise and lower the slide without danger of getting the two pitmans out of alignment with each other and with the guides.

This No. 3 press is largely used in the manufacture of armature discs, and it is specially adapted for operating large cutting, forming, perforating and bending dies. It can also be made without gearing, and with overhanging frame instead of the straight uprights shown. Its prin-

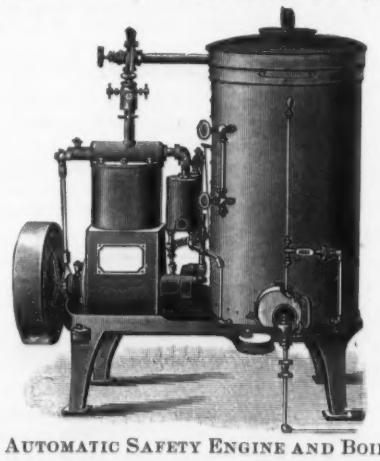


BLISS DOUBLE CRANK PRESS.

cipal dimensions are 36 inches between the uprights, 24 inch stroke, die space (up and down), 10 inches, 2 inch adjustment, height 90 inches, weight 5,500 pounds. The same firm also makes similar presses, several of which we have illustrated, in many other sizes up to 50,000 pounds in weight.

"Cataract" Electric Plants.

There is a great demand for the electric current in business places, offices, and city and country residences, where, at the present time, no commercial electric lighting company has circuits convenient for furnishing the same. To supply this demand the "Cataract Electric Plants" have been placed on the market by Mr. Frank C. Perkins, 629 Prospect avenue, Buffalo, N. Y. Where the water pressure is high and steady, and the water rates are reasonably low, the necessary power may be supplied by water motors, and generally they give very satisfactory results. The power is usually obtained, however, from the Acme automatic safety engine and boiler, shown in the accompanying illustration. This engine and boiler, when fired with either kerosene oil or natural gas, give satisfactory results in fuel economy. With this boiler three and three-quarters (3¾) gallons of oil will deliver 1 h. p. for 10 hours; and 1,000 feet of



ACME AUTOMATIC SAFETY ENGINE AND BOILER.

natural gas, at 4 ounces pressure, will deliver 2 h. p. for 10 hours, it is claimed. Where natural gas, as a fuel, sells at 25 cents per 1,000 cubic feet, the 2-h. p. engine will furnish power for a dynamo at from 2½ to 3½ cents per 1,000 watts.

The electric lighting companies usually charge from 12 to 20 cents per 1,000 watts, with a slight discount for prompt payment. The supply of water to the feed pump is automatically regulated by a ball float in a case, attached to the boiler, which controls the amount delivered by each revolution of the engine, and is adjusted to maintain the desired level of the water in the boiler under all the varying loads to which the engine may be subjected. An automatic fire regulator is used which reduces, or cuts off entirely, the supply of fuel oil when the steam pressure reaches the limit at which the regulator is adjusted.

The electrical equipment (see illustration) is furnished complete, and consists of compound wound dynamo,

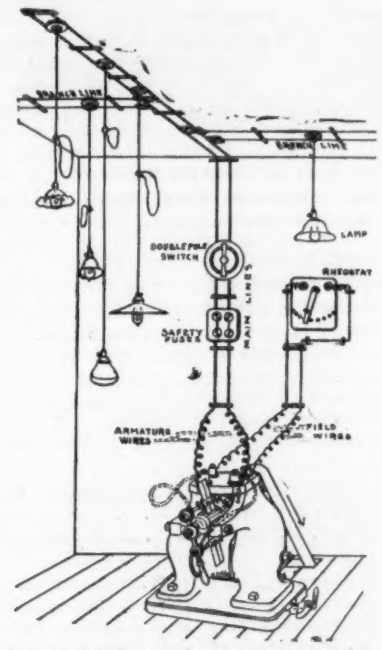
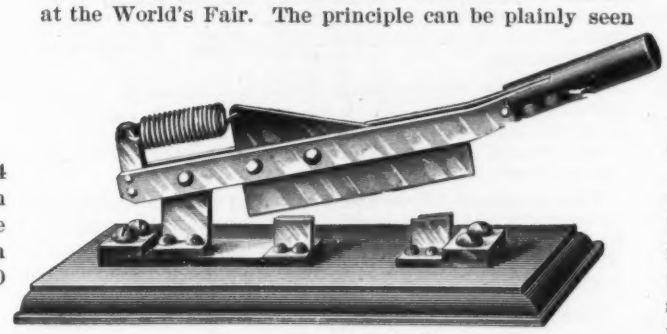


DIAGRAM OF CONNECTIONS OF COLBURN DYNAMOS.

rheostat, switches, lamps, sockets, rosettes, flexible cord, porcelain cleats, cut-outs, and, in fact, everything necessary for successful operation. The entire plant is practically automatic, and requires very little attention.

The C. & H. Switch.

A simple, yet effective, single pole knife switch has been recently placed on the market by Cutler & Hammer, Chicago, which can be seen in that firm's exhibit at the World's Fair. The principle can be plainly seen

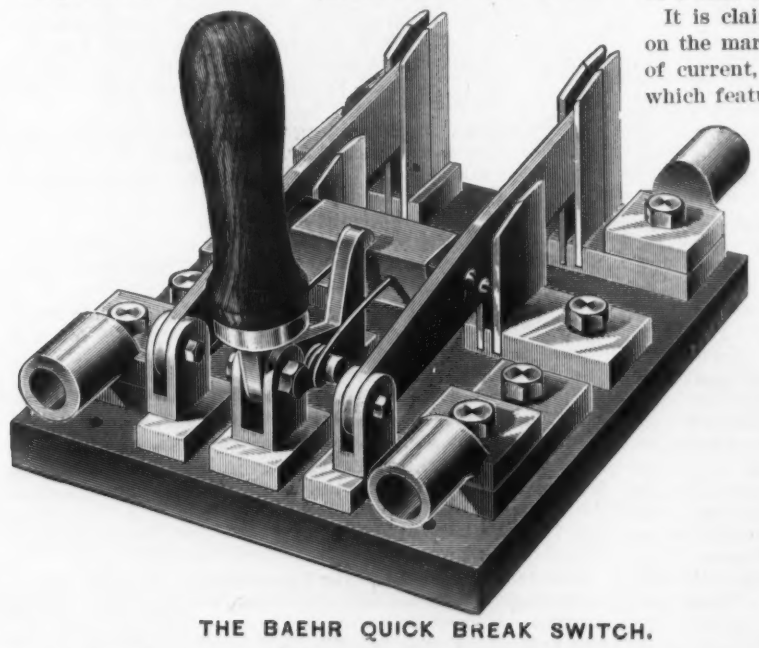


THE C. & H. SWITCH.

from the illustration, which shows the switch to be neat in appearance. Rolled brass and copper are used throughout in its construction. The switch was invented by Mr. H. H. Cutler, and is manufactured in a variety of styles and in sizes from 15 to 2,000 amperes.

The Baehr Quick Break Switch.

A new quick break switch has recently been placed on the market by the Brooklyn Electric Manufacturing Com-



THE BAEHR QUICK BREAK SWITCH.

pany, 289 Graham street, Brooklyn, that possesses features of interest, and has already been largely used in important installations. As clearly shown by the illustration, the quick break action is obtained by means of a spring coiled on projections on an extension of the handle; the spring is of imported music wire, and is in one piece, half coiled on one projection, and the end passed through a hole in the extension and the remainder coiled on the other side. The two knives of the switch are of hard rolled copper, and are separated by a piece of fibre of square cross section, the greater part of which is enveloped by a brass casing. The base is of polished black slate. The switches are made single, double and triple pole, single and double throw, and of sizes from 25 to 1,500 amperes. Twenty-five of these switches, from 50 to 1,000 amperes, have just been placed in the Hotel Regent, Brooklyn, and 11 of 25 to 500 amperes are now being made by C. P. Huntington's house, New York. The same company manufactured the switchboards for the above. A number of other important electric lighting orders are on hand. The switch is also made for electric railway work.

Queen Portable D'Arsonval Galvanometer.

In completing a line of portable testing instruments Queen & Co., Philadelphia, have placed on the market a D'Arsonval galvanometer, as illustrated, which deserves more than passing notice. It is of the type used heretofore in their testing sets, and is admirably adapted to laboratory or station measurements and for use as a detector of faults in line wire. The index is quite dead beat, so that rapid readings are possible, and because of the principle of construction employed magnetic fields and mechanical vibrations produce practically no effect.

As the galvanometer is a "zero" instrument, readings cannot be made by direct deflection, but to determine

PORTABLE D'ARSONVAL GALVANOMETER.

resistance a rheostat and bridge are necessary exactly as in regular testing sets.

For manufacturing companies, especially where quick work is an item, this instrument should prove of value. It is well suited for ascertaining the resistance of carbon filaments for incandescent lamps, and has been used for this purpose by some of the large lamp makers. As a simple ground detector the galvanometer is quite complete in itself, being conveniently mounted in a handsome mahogany case with leather strap.

The Star Ventilating Electric Fan.

We illustrate an attractive form of a fan and electric motor, which, unlike most others, is not open to reproach for unsightliness. The motor is neatly concealed by the ornamental basket at the bottom of the rod, and the fixture is suspended from a single hook concealed by the canopy shown, thus giving it the appearance of a neat chandelier.

It is claimed for the motor that, unlike many others on the market, it will not be injured by a sudden rush of current, due to an accidental stoppage of the fan, which feature is secured without the aid of complicated

STAR VENTILATING ELECTRIC FAN.

safety devices. The manufacturers are D. L. Bates & Bro., Dayton, O., who supply the motor wound for direct incandescent and arc conduits; for incandescent circuits they are wound for 110, 220 and 500 volts, and can be run in series of two or more on a 500-volt circuit. Special motors for any voltage are made to order.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

New York, July 10, 1893.

The General Electric Company's officials justified their declaration of the regular 2 per cent. dividend at a time when the more conservative element in the management wanted a reduction by presenting a statement of earnings that reveals a flattering state of affairs. The report shows that for the four months ending May, 1893, the net profits were $1,391,721; June net profits (partly estimated) were $360,000, so that for five months the profits of the company's business amounted to $1,751,729. Five months' accrued interest on the debenture bonds, five months' accrued dividends on the preferred stock and five months' accrued dividends at the rate of 8 per cent. per annum on the common stock, together call for $1,138,193, so that there is left a net surplus on June 30, 1893, of $405,202. This calculation, moreover, does not take into account the license and royalty stocks and other securities received since Jan. 31. No comparison with the previous year is possible, as the operations of the companies under the consolidated management did not commence till June 1, 1892. It is estimated that the factory profits for the six months ending Aug. 31 will be $2,300,000, leaving only $1,700,000 to be made up in the last six months of the company's year to swell the factory profits to the usual $4,000,000. This will be applicable to all dividends, as the royalties and dividends on royalty stocks are in themselves more than sufficient to pay the interest on General Electric bonds. And the profits may be even larger than outlined above, as operating expenses are being much reduced by cutting down the salaried list. A saving of from $150,000 to $200,000 per year is calculated to be effected by this means.

The Edison Electric Illuminating Company has just had listed in the New York Stock Exchange an additional $150,000 of the capital stock. This makes $7,923,000 in all now listed. The directors announce that bonds to the amount of $673,000 have been exchanged for stock, and this stock is now listed in the Exchange. It will be remembered that the holders of the $3,250,000 first mortgage 5 per cent. bonds had the option of exchanging their bonds for 6 per cent. stock between May 15 and June 15, and the fact that a majority did not assent to the plan has been much commented upon. It is argued, however, that this failure to get all the bonds in, is due to the disturbed condition of the country's finances, as investors were, in view of the prevailing distress, more disposed to hold on to a first mortgage 5 per cent. bond rather than a 6 per cent. stock on which dividends are not guaranteed. The company is understood, however, to be earning more than 6 per cent. and the directors this week declared the regular quarterly dividend of 1½ per cent. on the stock. It is payable Aug. 1 next.

Western Union Telegraph Company has been the weakest of all the electrical stocks this week, and rather a curious reason is offered to explain the decline in the stock. A stock market rumor of some consequence this week has been the report that the Vanderbilts are buying the control of the Reading Railroad. It is stated that the Vanderbilts are selling Western Union and buying Reading at present prices in the idea that the latter investment will pay very largely in the future on the money invested. This little explanation is somewhat upset by the fact that the Vanderbilts explicitly deny that they are buying Reading stock, and by the assertions of people supposed to know that the Vanderbilts do not own enough Western Union to sell enough to induce the existing weakness. Explanation must, therefore, be sought in other quarters, but no reasonable reason has yet been advanced. It is hoped by friends of the company that Mr. Gould back from Europe will give the family specialty better support than it has recently been receiving.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17½
Edison Electric Ill., New York	100	106	106
" " " 1sts	...	106	107
*Edison Electric Ill., Brooklyn	100	98	103
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	140
Edison Electric Light of Europe	..	2	6
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	12½	12¾
General Electric Company	100	71	71¼
" " deb. 5's	..	83	84
Interior Conduit and Ins. Co	100	30	40
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24	25
" " pfd	50	45	47

* Ex. div.

AFFAIRS OF THE COMPANIES.

The Siemens & Halske Electric Company of America, Chicago, has certified to an increase of stock from $500,000 to $1,000,000.

The Delta Electric Company, of Cairo, Ill., has elected the following gentlemen a board of directors: John A. Miller, Al. Lewis, H. Hasenjaeger, E. A. Buder, V. Neff, H. Shultze and Wm. Kluge. The secretary's report showed the affairs of the company to be in first-class condition.

The Canandaigua (N. Y.) Electric Light Company has changed its name to the Canandaigua Electric Light and Street Railroad Company, and the capital stock increased from $50,000 to $80,000. The directors for the new organization are: Willis H. Tutle, Maynard N. Clement, Alexander Grieve, M. Dwight Munger and Mary S. Munger.

The Penn Electric Light Company held its annual meeting June 27, at 310 Market street, Camden, N. J., at which these directors were elected to serve one year: Henry Clay, David H. Lane, W. D. Marks, C. W. Taylor, James McManes, Amos R. Little, W. F. Patton, A. J. De Camp and George W. Hill. The annual report of President De Camp showed a deficit of $3,861.40.

The Wenstrom Dynamo Company, Baltimore, Md.—The Baltimore Circuit Court has ordered that the receivers of the Wenstrom Dynamo Company collect all unpaid subscriptions to the capital stock of the company, and that such dividends as have heretofore been audited to those liable for such unpaid subscriptions be withheld until settlement of such liability. The amount to be thus collected is said to be $250,000.

The Tri-City Power and Light Company, with a paid up capital of $300,000, will operate in Rock Island, Moline and Davenport, Ill. The following officers have been elected: For president, B. E. Sunny, of Chicago, Western manager of the Edison General Electric Company; for vice president, S. M. Hamill, of Cleveland, O., general manager of the Brush Electric Company; for secretary, R. H. Macmullan, manager of the Brush Electric Company's Rock Island branch; and for treasurer, Wm. Mullen, president of the Davenport Power and Light Company. With S. A. Douglass, manager of the Chicago Branch of the Brush company, and B. E. Watson, of St. Louis, an electrician, the officers constitute the Board of Directors.

NEW INCORPORATIONS.

The City Illuminating Company, Chicago, Ill., capital stock $6,000, has been formed to furnish electricity for various purposes. M. B. Austin, R. H. Watson and H. W. Ames are interested.

The Electric Light, Heat and Power Company of Gettysburg, Pa., capital stock $25,000, has been formed to supply light, heat and power. E. M. Hoffer, H. G. Walmer and Harvey B. Hauck are the promoters.

The Cleveland Crosstown Street Railroad Company, Cleveland, O., capital stock $10,000, has been formed for the purpose indicated in its title. The promoters are S. H. Short, J. Potter, L. A. Russell and W. C. and G. F. Scofield.

The McCay, Howard Engineering Company, Baltimore, Md., capital stock $5,000, has been formed to deal in electric light plants, etc. H. C. McCay, R. Howard, A. H. McCay, A. Hamilton and L. E. Wolfe are the organizers.

The Portsmouth Street Railroad Company and Light Company, Portsmouth, O., capital stock $125,000, has been formed for the purposes indicated by its title. S. B. Timmonds, J. F. Brushart and F. L. Smith are the promoters.

The Electric Light, Water and Milling Company, Milwaukee, Wis., capital stock $80,000, has been formed to erect and operate water works and electric light plants. J. Seevelund, J. Davidson and W. Schlosser are the promoters.

The Butte Manufacturing and Electric Power, Heating, Lighting and Elevator Company, Butte, Neb., capital stock $25,000, has been incorporated. The parties interested are W. D. Forbes, D. W. Forbes, G. T. Bastedo and S. C. Sample.

The West Side & Gordon Park Street Railroad Company, Cleveland, O., capital stock $10,000, has been formed to build and operate a railway. W. C. Scofield, C. W. Scofield, G. F. Scofield, S. H. Short and L. A Russell are the interested parties.

The Hornberger Electric Manufacturing Company, Elkhart, Ind., capital stock $20,000, has been formed to manufacture and sell electrical apparatus of all kinds, etc. W. H. Hornberger, C. A. Hornberger and J. C. Boss, Elkhart, Ind., are the promoters.

The Orient Electric Company, Youngstown, O., capital stock $60,000, has been formed to manufacture and repair electrical machinery, arc and incandescent lamps, etc. F. W. Brown, L. S Denison, C. O. Shatto, F. C. Brown and A. L. Powers are the incorporators.

The Adams Electric Manufacturing Company, Chicago, Ill., capital stock $500,000, has been formed to manufacture and deal in all kinds of electrical machinery, appliances, etc. Wm. B. Mather, Wm. L. Sutherland and Jas. S. Wheeler, Jr., are the incorporators.

The New York & Dallastown Electric Railway Company, York, Pa., capital stock $60,000, has been formed to construct and operate an electric railway from York to Dallastown, Pa. F. Geese, L. A. Marshall and Grier Hersh, all of York, are the incorporators.

The Pentz Reckenzaun Electric Company, Philadelphia, Pa., capital stock $30,000, has been formed to manufacture electrical apparatus. A. J. de Camp, C. D. Norton, L. W. Fox, Thos. Schaffer, Philadelphia, and Lincoln Godfrey, Marion, Pa., are interested.

The Elsinore Electric Power and Water Company, Elsinore, Cal., capital stock $200,000, has been formed to erect and maintain electric light and power plants, etc. J. F. Jones, Elsinore; R. D. Wellman, Redlands, and Dawson B. Day, Downey, Cal., are the promoters.

The Merchants and Manufacturers' Electric Light, Heat and Power Company, Erie, Pa., capital stock $50,000, has been formed to manufacture and supply electricity for the purposes indicated in its title. E. D. Carter, E. O. Siegel and J. S. Rill ing are interested.

The Pittsburgh, Grafton & Mansfield Street Railway Company, Pittsburgh, Pa , capital stock $500,000, has been formed to construct and operate an electric railway in Allegeney County. T. S. Bigelow, Wm. J. Burns and Jno. C. Reilly, Pittsburgh, are the promoters.

The New Jersey Improvement Company, Camden, N. J., capital stock $150,000, has been formed to construct and equip railways, electric light and power plants, and to supply light, heat and power. The promoters are L. C. Maus, B. F. Wagner and T. T. Hansen, all of Philadelphia, Pa.

The College & Grandview Electric Street Railway Company, Beaver Falls, Pa., capital stock $15,000, has been formed to construct and operate an electric railway in College Hill, Pa C. P. Wallace, J. P. Sherwood and A. R. Loyda, Beaver Falls, Pa., are interested parties.

The Chelora Brade Sewage and Electric Light and Power Company, Atlantic City, N. J., capital stock $15,000, has been formed to supply and distribute electricity. H. Monback, D. S. Dengler, E. Wood, Philadelphia; I. G. Adams, E. Ford and W. Riddle, Atlantic City, N. J., are interested.

The New Hampton Electric Light and Power Company, New Hampton, Ia., capital stock $15,000, has been incorporated for the purposes indicated in its title. T. C. Clary, L. L. Briggs, J. F. Babcock, A. Babcock, E. G. Porter and D. K. Gardner, of New Hampton, are the interested parties.

The Tri-City Power and Light Company, of Rock Island, Ill., capital stock $300,000, has been incorporated to manufacture appliances for furnishing light, heat and power, and to supply light, heat and power by electricity, etc. R. M. MacMillan, Wm. Mullen and Jas. F. Huges are the promoters.

The Krogh Manufacturing Company, San Francisco, Cal., capital stock $100,000, has been formed to manufacture and deal in machinery and to supply electricity, etc. H. K. Olson, Wm. McCrindle, Oakland, Cal.; P. W. Krogh, Jos. Baker and T. J. Krogh, of San Francisco, Cal , are the incorporators.

The Albert Lea Electric Company, Albert Lea, Minn., capital stock $35,000, has been formed to generate and sell electricity for light and power purposes, to operate telephones, street railways, etc. The promoters are C. G. Edwards, S. H. Cady, W. E. Todd, Harry Jones, and S. S. Edwards, all of Albert Lea.

The Knickerbocker Electric Light and Power Company, Flatbush, N. Y., capital stock $30,000, has been formed to generate and supply electricity. R. Ficken, Flatbush, L. I.; Thos. Murtha, 29 W. Fortieth street, New York City, and Richard Ulman, First avenue and Sixtieth street, New York City, are interested.

The Twin City General Electric Company, Ironwood, Mich., capital stock $100,000, has been formed by a consolidation of the Ironwood Electric Company and the Twin City Railway Company. D. M. Kimball, E. D. Nelson, H St. Johns, J. F Lyon, E. T. Larson, Thos. Nelson, W. H. Cochrane and L. L. Bliss are the promoters.

The Automatic Electric Railway Signal Company, New York City, capital stock $3,000, has been formed to manufacture and sell automatic railway signals. C. E. Senior, Jr., 1855 Lexington avenue; Wm. R. Robins, Ozone Park, New York City, and C. S. Longhurst, 440 Pacific street, Brooklyn, N. Y., are the promoters.

The C. & C. Electric Company, of Newark, N. J., has been started with a capital stock of $1,400,000, to manufacture and deal in electric motors, dynamos, etc., and to generate electricity for light and power. J. L. Wilkie, Flushing, N. Y.; Geo Dana Mumford, New York City, and L. McK. Garrison, Orange, N. J., are the incorporators.

The International Storage Battery Company, Detroit, Mich., capital stock $100,000, has been formed to make and sell the Woodward tubular secondary electric storage battery and other electrical appliances. H. Woodward, Toronto, Canada; Stephen J. Martin, DeWitt C. Meade and G. W. Martin, of Detroit, Mich., are the promoters.

The Woodbridge & Sewaren Electric Street Railway Company, Woodbridge, N. J., capital stock $50,000, has been formed to build and construct a railway. C. W. Boynton, J. E. Barry, Woodbridge, N. J.; H. Maurere, New York City; B. G. Walcott, Fishkill; J. H. Johnson, New York City, N. Y.; W. T. Adams and G. L. Boynton, Sewaren, N. J., are the parties interested.

The Rockport Electric Street Railway Company, Rockport, Mass., capital stock $50,000, has been formed. G. E. Bradford, L. Grimes, H. N. Woods, E. G. Abbott, J. Tufts, F. Scripture, Z. A. Appleton, N. Richardson, J. P. Meriden, A. Rowe, W. R. Parker, E. Canney, J. L. Woodfall, C. S. Rogers, E. Knowlton, T. T. Harwood, A. M. Tapper and L. B. Grimes are interested.

The YoungMoskowitz Railway Car Electric Lighting Company, Newark, N. J., capital stock $1,000,000, has been organized for the purpose indicated in its title, and to deal in other electric and railway apparatus. The following are interested therein: C A. Sterling, East Orange; J. F. C. O'Reilly, Orange; L. D. Adler, J. F. Connelly, J. Loewenberg, H. C. H. Herold, S. Young, E. B. Gaddis, M. Moskowitz and B. W. Harper, of Newark, N. J.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, July 10, 1893.

Mr. Wm. C. Vail and family are summering at Asbury Park, N. J.

Mr. A. A. McCreary and family are sojourning in northern New York.

Mr. T. W. Snow, assistant general agent of the U. S. Wind Engine and Pump Company, of Batavia, Ill., was in town for a few days last week.

Mr. F. B. Sharp, manager of the Brooklyn Electric Manufacturing Company, left town Saturday last, bound for the World's Fair and the West.

Mr. G. W. Godfrey, general manager of the New York Insulated Wire Company, 13-17 Cortlandt street, is in Chicago greeting the many old and making many new friends.

Mr. Arthur E. Bowers, 95 Nassau street, has been appointed New York agent for the "Novak" lamp, manufactured by the Claflin and Kimball Company, of Boston, Mass.

Mr. J. Burns, dealer in electrical supplies, 16 Rue Portefoin Paris, arrived from France, July 3, per steamer "Berlin," en route to Chicago. Mr. Burns returns by steamer "Paris," July 26.

Mr. George Stanton, of the U. S. Wind Engine and Pump Company, Batavia, Ill., in company with Mr. T. W. Snow, assistant general agent of the company, paid this office a welcome visit last week.

Telephone Pay Stations.—Three stations have been placed in the reading-room of the Fifth Avenue Hotel, making four in all. Before the new ones were added, customers often stood in line waiting their turn to telephone.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., June 29, 1893.

The Morse Elevator Works, Morse, William & Company has removed to 19 Pearl street, Boston, Mass.

The H. & H. Electrical Company, the Boston representative of the Belknap Motor Company, has removed its office to 42 Oliver street.

The American Bell Telephone Company will pay a dividend of $3 per share and an extra dividend of $3 per share on July 15, 1893, to stockholders of record at the close of business on Friday, June 30. The transfer books will be closed from July 1 to July 15, both days included.

New England Electric Club.—At a directors' meeting held June 30, it was voted to sell the property of the club, and transfer the lease of its clubhouse to the Boston Press Club. The latter club extends to the members of the late New England Electric Club the privilege of becoming visiting members of the club on payment of the regular dues.

WESTERN NOTES.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago, June 17, 1893.

Alex. Dow, of Chicago, has been appointed city electrician for Detroit at a salary of $3,000.

F. N. Howard has been appointed agent to represent the Fontaine Crossing and Electric Company, of Detroit, for Chicago office, 23 Rialto Building.

The American Electro-Therapeutic Association will hold its third annual meeting in Chicago, Sept. 12, 13 and 14, at Apollo Hall, Central Music Hall Block.

F. B. Rae and Prof. Carhart, of Ann Arbor, Mich., have been appointed consulting electrical engineers for selecting location and construction of city electric light plant for Detroit.

OREGON CITY, Ore., July 3, 1893.

Chief Electrician W. C. Cheny, of the Portland General Electric Company, has returned from the East, where he has been for some time on business concerning the company.

The Gladstone Branch of the East Side Railway Company, of Portland, Ore., is about completed to Gladstone Park, near Oregon City. Residents of Gladstone will pay five cents for the trip between that point and Oregon City.

The Olympia Light and Power Company, of Olympia, Wash., has been asked to make a formal proposition to transmit 300 h. p. over the wire to operate dredging machinery in the harbor, which is being improved by government contractors according to the plans proposed by the harbor line commissioners. Kumwater Falls will be utilized, having a capacity of 9,000 h. p.

The Portland General Electric Company has just installed in its Oregon City station five T.-H. transformers, class AB, each having a capacity of 40 kilowatts. Instead of a direct step up from 1,000 volts to 5,000, as has been the usual practice, the five transformers are connected in series, with a dynamo having a potential of 1,150 volts, which is run so as to give about 5,000 volts on leaving the transformers. At the sub-station in Portland four transformers are connected in series, giving about 4,000 volts there.

CANADIAN NOTES.

OTTAWA, June 30.

The Toronto & Scarboro Railway is nearly completed for traffic.

Kingston, Ont.—The cars for the electric street railway service have been ordered from St. Catharines' manufactory.

Hamilton, Ont., has just voted a bonus of $25,000 towards the construction of the Hamilton, Grimsby & Beamsville Electric Railway.

An injunction has been issued to prevent the Ottawa City Passenger Railway relaying their track for electric instead of the old horse-car system.

Toronto.—The City Council of Toronto has decided that the people may vote on the Sunday street car question on Aug. 2, the street railway company to pay all the expenses.

Moncton, N. B., is agitating for an electric street railway service. It is estimated by those who have the project in hand that, say, three miles belt line, double track, six cars, could be provided at an expenditure of $75,000.

Col. James M. Clark, of Windsor, promoter of the South Windsor & Amherstburg Electric Railway, is at London, Ont., in connection with the construction of an electric street railway for that city. He also favors the belt line proposal.

Hamilton, Ont.—B. B. Osler, Q. C., president of the Hamilton and Dundas Street Railway Company, was in the city last week, relative to the substitution of the trolley system for the dummy motors on his road, which matter has been referred to the Board of Works.

The Toronto Street Railway is endeavoring to secure a lot near its present Frederick street property on which to erect a foundry. It is the company's intention to manufacture everything necessary in the building of their cars and motors, even to casting the wheels.

President J. W. McRae, of the Electric Railway Company, at Ottawa, Ont., states that the receipts of the company during the past year were $109,000. The number of fares was 2,394,000, while $10,000 was added to the "rest" account, declared on the capital stock.

Ottawa, Ont.—A trivial but interesting case was decided here this week by the Supreme Court. One O'Connor sued the Novia Scotia Telephone Company for mutilating his trees while stringing wires. The Nova Scotia courts decided in favor of the company, but the Supreme Court reversed the decision.

St. Stephens, N. B.—The electric railway company is ready to undertake the building of a new road as soon as the Town Councils of St. Stephen and Milltown locate the line as required by the terms of the company's charter. The road will be built in Calais, no matter what action is taken on the St. Stephens side.

Halifax, N. S.—The longest telephone circuit in the world is now projected by the Automatic Telephone and Electric Company of Canada, which intends to lay a line from Halifax to Vancouver. This is a distance of 3,500 miles. The circuit will be in sections, and available for communication to many intermediate points.

Toronto Junction.—The City Council have decided not to dispose of the electric plant, and have voted down the following resolution: "That the offer of the Toronto Incandescent Electric Light Company for the purchase of the town's electric system at $26,100 be accepted, provided the company enter into the agreement forthwith."

The Ottawa Electric Street Railway Company at its annual meeting decided to start car shops as an independent enterprise for the manufacture of electric cars. The capital will be $50,000, and the works will employ 100 men. Cars built here under the supervision of the electric railway management have already found their way to Montreal, Windsor and Winnipeg.

Toronto.—The opponents of the Sunday street car service are organizing. The organization is known as the Sabbath Observance Committee, formed to oppose Sunday cars. They held a meeting, at which the plan of campaign was mapped out. Senator Allan occupied the chair. Counter petitions will be circulated. Oppositions will not be on the ground of Sunday quiet, but because Sunday cars are a breach of Sunday observance, as laid down in the Divine laws.

President Molson, of the Molson Bank, who has just returned from British Columbia, says the electric railway service between Vancouver and New Westminster would be a credit to the oldest and richest state in the world. It is the longest straight line in Canada and runs a portion of the way through the primeval forest and past the loveliest scenery. Moreover, it is thoroughly equipped and its system so perfected that never a hitch can happen.

Peterboro, Ont.—Work is being pushed rapidly forward on the electric street railway. The work of placing the ties in position and laying the rails is completed from the Hilliard Mills to Smith street, on Water street; over half a mile being completed in all. A writ for an injunction has been served on the town and the Peterborough & Ashburnham Electric Street Railway Company, to restrain the construction and operation of an electric street railway on George street, between Brock and Charlotte streets.

The Restigouche Telephone and Electric Light Company has lately organized, with headquarters at Campbellton. The provisional directors of the company are James Reed, Geo. Moffat, W. W. Doherty, Kilgour Shives, A. E. Alexander, J. P. Mowatt and David Richards. It is the intention of the company to extend the line to Dalhousie, a distance of sixteen miles, and to Metapedia, a distance of twelve miles, thus taking in the principal points on the Restigouche River.

The Keewatin Power Company, with a capital of $1,000,000, is applying to the Ontario government for a charter to supply hydraulic and electric power for the said purposes, to acquire from the Keewatin Lumber Company and other parties Tunnel Island and other islands in the waters of the Winnipeg River and Lake-of-the-Woods, and other islands and lands on the adjacent shores, and to improve the same and utilize the powers in respect of the water area incident, by law or otherwise, to the ownership so to be acquired.

Victoria, B. C.—The National Electric Tramway Company has completed the purchase of the lighting plant from F. H. Osgood, of Seattle, who has controlled and operated it for the last two or three years. The consideration was about $50,000, and the equipment purchased consists of dynamos, 30 miles of wire and 3,700 lamps installed. It is the intention of the tramway company to treble the capacity of the lighting plant immediately, its plan involving the employment of Goldstream water power for the generation of both tramway and light currents.

Hamilton, Ont.—The City Clerk has received a letter from the president of the Hamilton & Dundas Railway Company, inclosing a petition asking that the city by-law under which the road is operated be amended, so as to empower the working of the line by electricity on the trolley system. The present by-law provides that the motive power shall be dummy steam engines, and restricts the company to a single track. It is proposed that the road be almost entirely rebuilt as a double-track system, or with double tracks over the whole or any part of the roads in the city that the directors may decide upon. The privilege of erecting all the necessary poles, wire, etc., is asked for, with the additional privilege of running wires to Ainslie Park for the lighting of that resort by electricity. The new privileges asked for, it is proposed, shall extend from July 1, 1893, over a number of years, to be decided upon by the City Council.

Toronto.—Toronto & Mimico Electric Railway is dropping into the possession of the Toronto Street Railway Company. The price is as yet a secret. The papers are being drawn up, and the deal is practically certain to be complete within a few days. This suburban line is owned by a company composed principally of Messrs. Barlow Cumberland, Andrew Darling, O. L. Hicks and Lawyer Pinkerton. The line stretches from a point on the Lake Shore road a few yards west of the Grand Trunk tracks to Mimico. The road was operated for a few weeks last summer, but the electric plant gave out and the system has been in litigation ever since. It is now practically the property of the Toronto Street Railway Company, and a man who knows declares that electric cars will be running as far as the Humber early next month. The Toronto company will have to extend its tracks over the Grand trunk crossing before it can connect with the Toronto & Mimico line.

Montreal.—The electric cars are running permanently on St. Denis street. There are now 30 "electrics" on the different routes. This number will be increased to 60 as soon as all the four generators in the Cote street power house are running, and that, it is said, will be very shortly. So far this season new tracks had been laid past the Windsor and soon the double track on St. Catherine street from St. Lawrence street to St. Matthew street, will be completed. A mile of single track had also been laid east of St. Lawrence on St. Catherine street and a double track from the city limits to Greene avenue, Cote street, Antoine. On St. James street a line had been built from Windsor to Fulford street, and on Notre Dame street from Chaboillez street, to St. Lambert Hill. A double track from St. Catherine street to Sherbrooke and from Pine avenue to the Exhibition grounds had also been built this season. There are at present 600 men on the work and by the end of the summer the company hopes to have its lines in very good shape. Some people are objecting to the putting up of the iron trolley poles opposite their business places, and consequently there is some delay in that branch of the work.

ENGLISH NOTES.

LONDON, June 21, 1893.

Electric Supply Business in London.—An analysis of the Board of Trade returns of the London electric supply companies shows a marked improvement all round in the economy of central station working on all systems. During the past year the demand for electricity supply has increased more than 80 per cent.

Electric Traction and Telephony.—The joint committee of both Houses of Parliament appointed to consider the questions of protective clauses to be inserted in private bills met for the first time on Monday last, Viscount Cross presiding. The claim which the National Telephone Company makes is that as licensees under the government they are entitled to the use of an earth return and protection from the leakage currents of electric traction lines. On the other hand, the electric traction engineers claim that even with a metal return they cannot prevent leakage currents from affecting an earth return telephone line. No definite clause for insertion in private bills has as yet been put forward in the telephone interests. Evidence has been given by Sir Courtenay Boyle, of the Board of Trade; by Mr. W. H. Preece, of the Post Office, and by the general manager of the National Telephone Company. The parties interested and represented by counsel are the National Telephone Company, the railway companies, the gas and water companies, the electric tramway companies and the underground electric railway companies, the Tramway Institute of Great Britain and Ireland and H. M. Postmaster-General. Among those not represented are the London County Council and the electric lighting companies.

News of the Week.

ELECTRIC LIGHT AND POWER.

Hart, Mich., is to have the electric light.

Jasper, Md., is soon to have the electric light.

Niles, Mich., is to vote on a municipal lighting plant.

Lansing, Mich., has voted for a municipal lighting plant.

Hillsdale, Mich., has decided in favor of a municipal plant.

Newcastle, Utah, is taking steps to secure an electric lighting plant.

Madison, Wis., will consider the question of a municipal plant.

Atlanta, Ill., has granted an electric light franchise to F. L. Copps.

Paw Paw, Mich., has placed its electric light bonds on the market.

Idaho Falls, Idaho, is agitating the question of electric lighting.

Detroit, Mich., will renew its street lighting contract from month to month.

Batavia, N. Y., by a vote of 229 to 38, has appropriated $23,000 for an electric plant.

The South Norfolk, Va., Water and Electric Light Company has purchased a site in Berkeley.

Belem, Grand Para, Brazil, asks bids for an electric light plant; the bids will be opened Nov. 1.

Humboldt, Tenn.—The Council of Humboldt is considering the erection of an electric lighting plant.

The Green Bay, Mich., & Fort Howard Electric Light and Gas Company is improving its electric plant.

Weston, W. Va.—The local electric lighting plant has been burned; the loss is $10,000 and insurance $1,500.

Westfield, Mass., capitalists are projecting an electric plant to supply light and power throughout Hampden County.

St. Paul, Minn.—An ordinance is before the City Council authorizing the city clerk to call for bids for lighting the city.

Berkley, Va.—The Berkley & South Norfolk Water and Electric Light Company has bought land upon which to erect its proposed plant.

Peabody, Mass.—P. L. Winchester, of the Special Committee has filed a report with the Town Council in favor of adopting the alternating system, and the recommendation was adopted.

Worcester, Mass.—The State Gas and Electric Light Commission have annulled the permission granted by the city authorities to the Quinsigamond Electric Power and Light Company, to compete with the present company.

Madison, Wis.—The Street Lighting Committee of the City Council has advertised for bids for doing the city lighting for a period of several years by private corporations, and also for the putting in of an electric lighting plant for the city.

Montpelier, Vt.—Jas. R. Langdon, of Montpelier, Vt., is at the head of the syndicate which will build a dam at the village of Carver Falls, near Fair Haven, Cayuga county, N. Y., and will furnish power for an electric lighting plant for Fair Haven.

Train Lighting.—The New York Central is preparing, it is said, to light its cars by electricity. Connected with an axle of each car will be a small dynamo, and the electricity generated while the car is in motion is to be accumulated in a storage battery when needed.

Washington, D. C.—Sealed proposals will be received to Aug. 1 for lighting the streets of the District of Columbia for a period of ten years or less. Specifications and blank forms of proposals will be furnished on application. J. W. Ross, M. M. Parker, W. T. Rosselle, District Commissioners.

Stoneham, Mass.—A meeting of the Boards of Stoneham, Wakefield and Reading was held in the office of the town clerk of Stoneham with regard to establishing an electric lighting plant for their joint uses, but it was decided to await the action of the Wakefield authorities with regard to intended purchase of the plant of the Wakefield Gas Company.

Rome, N. Y.—In accordance with the recommendation of the special committee on electric lighting, the said committee has been authorized by Common Council to employ a first class electrical engineer to make surveys, compute cost and prepare plans and specifications for an electric lighting plant. Superintendent Higgins, of the Rome Gas Light and Electric Company, has been invited to meet the committee at their next meeting.

THE ELECTRIC RAILWAY.

Gallitzin, Pa., is considering an electric railway to connect with Cresson.

Millbury, Mass., has granted a franchise to the Blackstone Valley Railway.

The Cambridge and Edinboro, Pa., electric railway will soon be taken in hand.

The Elmira, N. Y., & Horseheads Railroad Company will extend its electric line.

Kingston, N. Y., has granted important franchises to the Colonial Electric Railway Company.

Middletown, N. Y., has granted an electric franchise to the Middletown & Goshen Traction Company.

The Waco, Tex., Street Railroad and Light Company will spend $100,000 on extending its plant.

The Hinsey Electric Line, Milwaukee, Wis., has been sold to Charles Pfister, who will turn it over to the Milwaukee city company.

Middletown, N. Y.—The Common Council has granted a franchise to the Middletown & Goshen Traction Company to operate an electric street railroad.

The Cambridge (Pa.) "Enterprise" is authority for the statement that the Cambridge & Edinboro Electric Railway will be built as soon as franchises can be secured.

Frederick, Md.—Surveys are now being made for the proposed electric railway to connect that town and Middletown. Lorne N. Downs is president and E. L. Miller is secretary.

Pittsburgh, Pa.—The Schenley Park and Highland Electric Railway Company has increased its capital stock from $100,000 to $300,000 for improvements, and cars will soon be running.

Millbury, Mass.—The Board of Selectmen have granted a franchise to the Blackstone Valley Street Railway Company to operate a street railway there and work on the road will soon be commenced.

Kingston, N. Y.—The Colonial City Electric Railway Company has been granted a franchise to operate an electric road through certain streets of the city, the road to be completed within one year.

Oakland, W. Va.—The project of connecting Mountain Lake Park and Oakland by an electric railway is being considered by Pittsburgh capitalists, and the outlook is favorable for the building of the road.

Baltimore, Md.—Messrs. E. D. Smith & Son have received the contract for transforming the Maryland avenue, Park avenue and John street division of the City and Suburban Railway into an electric road.

Jamaica, L. I., N. Y.—Ex-Supervisor F. W. Dunton, of Jamaica, is president of the Boynton Bicycle Railroad Company, which will build a road from Patchogue to Brooklyn, and surveys are now being made.

Worcester, Mass.—The Worcester and Millbury Electric Street Railway Company is to increase its capital stock from $150,000 to $300,000, part of which will be devoted to improvements in the equipment of the road.

Dedham, Mass.—The Norfolk Suburban Street Railway Company, capital stock $75,000, has filed papers preliminary to a charter for a road from that town through Mattapan to Hyde Park, to be 7½ miles long.

Woodbury, N. J.—The Camden, Gloucester & Woodbury Electric Railway Company has petitioned the Common Council for

right of way for an electric railway, and the Council has appointed July 14 as the day for official hearing.

Xenia, O.—Wayne Hoff, of Cincinnati, O., has been in Xenia representing outside capitalists who wish to secure right of way from the city and county officials for an electric road to run from there to Springfield via Yellow Springs.

Montreal.—The Corriveau-Williams Electric Railway is being rapidly built, and one line is expected to be finished by Sept. 1. Mr. Corriveau has emphatically denied that he will unite his interests with the Montreal Street Railway Company.

White Plains, N. Y.—The Board of Trustees is to consider the application of the Elmsford & White Plains Electric Railway Company and of the White Plains & Mamaroneck Street Railway Company for the privilege of laying rails and operating an electric railway through the streets of the town.

Amsterdam, N. Y.—General Mananger Snell, of the Amsterdam electric road, states that surveyors are now at work on the proposed extension to Johnstown and Gloversville, and that the road will be built to these points within a year. He also states that the extension can be built and equipped for $200,000.

The Belt Line Electric Road and the Short Electric Road, of Shreveport, La., have been consolidated and placed under one management, through Percy Thompson & Co., investment bankers, 3 New street, New York, who placed the consolidated securities of the new company. The company is now operating 15 miles of road, and proposes to extend five miles further.

Worcester, Mass.—The Consolidated Street Railway Company and the Worcester Electric Light Company have contracted for another 500-h. p. generator, to be located at the works of the latter, to furnish power for the Main street and West Side lines. General Manager Akerman, of the street railway company, states that both these lines will be operated by electricity before the New England Fair opens in September.

Wilkes-Barre, Pa.—A company is trying to get the privilege of laying an electric road through certain streets in Plymouth. Another company is asking to be allowed to put its tracks through certain streets in Kingston, ostensibly to run from Wilkes-Barre to Harvey's Lake. Still another company is asking, and has, in fact, secured the right of way through Luzerne Borough with the expressed intention of making a terminus at Harvey's Lake.

Weiser, Idaho.—The Idaho Electric Railway, Light and Power Company has been incorporated. The company is composed of Ohio capitalists and local residents, and the object is to construct an electric railway from Weiser to Seven Devils. H. F. Randall, who was sent out from Ohio a couple of months ago, is now in the upper valleys in company with Weiser gentlemen, securing rights of way. Surveyors are now at work in the Weiser Cañon.

LEGAL NOTES.

Pole Tax.—Many cities are taking advantage of the recent St. Louis U. S. Court decision to tax telegraph and other poles.

The American Bell Telephone Company has filed in the United States Circuit Court at Chicago suits to perpetually restrain William Hubbard & Co. and the Cushman Telephone Company from manufacturing and selling the appliances those companies are now putting on the market. The complaints recite the history of the Bell telephone patents and the litigation over their ownership, and assert that the defendant companies are using unexpired patents owned by the Bell company, and putting their machines on the market at rates which injure the Bell company's business. The Bell company asks for injunctions and whatever damages the court may award.

Fixtures of Electric Lighting Plant.—Certain land, with water power, was leased for use in the operation of an electric lighting plant, and the lessee built on a solid stone foundation laid with mortar, a substantial dynamo house, in which he placed two dynamos; also a boiler house of rough lumber upon sills laid on stone or blocks, and a shaft house or shed, constructed for the most part of old lumber from buildings on the premises. He also erected a shafting 29 feet long, resting upon trestles imbedded in the ground to the depth of 2 feet. The buildings, as well as the machinery, were accessory to the trade, and, therefore, trade fixtures subject to removal by the lessee on the termination of his lease.—(Brown v. Reno Electric Light and Power Company, Circuit Court, D. Nevada, 55 Fed. Rep., 229.)

PERSONAL NOTES.

Mr. W. H. Preece, of London, will leave England on the "Paris," Aug. 5, arriving here about Aug, 12.

M. E. Hospitalier, of Paris, arrived in New York on the "Champagne," July 9. M. Hospitalier has accepted an invitation to read a paper before the Electrical Congress.

Mr. A. Welzin, of the E. W. Bliss Company, was married Wednesday, July 12, to Miss Rae Webster, daughter of Capt. Webster, U. S. N., at the home of the bride, 512 South Forty-first street, Philadelphia, Pa. Mr. and Mrs. Welzin are passing their honeymoon at Lake George and neighboring resorts.

Mr. Oscar S. Bussman, superintendent of the lamp factory of the Allgemeine Electricitäts Gesellschaft, Berlin, Germany, is on a visit to the United States to see the World's Fair. Mr. Bussman is well known by those connected with the Philadelphia Electrical Exhibition, of which he was a juryman.

Prof. Dr. von Helmholtz, president of the Physikalisch-Technische Reichsanstalt, Berlin, has been commissioned by the Imperial government to proceed early in August to Chicago, to attend the Electrical Congress. He will be accompanied by Drs. Feussner, Lummer, and Pringsheim of the Reichsanstalt, who have been engaged in investigations relating to subjects to be considered by the Chamber of Delegates of the Electrical Congress.

Dr. Wilhelm Wedding, lecturer at the Polytechnic, Charlottenburg, near Berlin, Germany, and first assistant in the Electrotechnical Laboratory, has been deputed by the Prussian Ministry of Commerce to proceed in July to America for a three months' stay, for the purpose of acquainting himself with the status of electrical work there generally, and particularly as exemplified at the World's Fair.

Mr. Nelson W. Perry, of the editorial staff of The Electrical World, was married on Wednesday, June 28, to Miss Marie Bedell, of Brooklyn. Immediately after the ceremony the happy couple left for Chicago where they are now receiving the congratulations of their many friends. Mr. Perry is well known in the West, as in the East, for his journalistic abilities and charming personal qualities.

MISCELLANEOUS NOTES.

David Maloney has been appointed city electrician of James town, N. Y., to superintend the city electric light plant and fire alarm system.

Electricity from City Refuse.—At Southampton, England, house refuse is burned in a "destructor" and the waste heat utilized to produce electricity.

Electrical Planes.—In some of the Glasgow shipyards an electrically driven rotary planer is now used for smoothing the decks of ships—an operation which when performed by hand is exceedingly laborious. The machine looks like a lawn-mower and is handled in much the same way.

Samuel W. Gear, of Rochester, recently received a patent covering a laterally moving trolley wire for canals, one which moves sideways in accordance with the movement of the boat and permits the trolley wheel to be kept constantly in electric contact with the conductor. A practical experiment will be tried this summer on the Erie Canal.

"Industries" (London) has combined with the old journal *Iron*, and the two will hereafter be issued as one paper. *Industries* is a journal widely known, both in and out of the electrical field, and it has deservedly obtained a high rank among its contemporaries. It is presumed that the present high standard will be maintained in the future.

The American Institute of Electrical Engineers has issued a new catalogue of the Institute, revised to July 1. It embraces some new features, among them the geographical distribution of the members, a calendar of meetings, the rules, and an imprint of the badge. Copies will be mailed to members or others upon application to the secretary, Mr. Ralph W. Pope, at the World's Fair or the New York headquarters of the Institute.

Buffalo Photometric Tests.—Prof. Vandenburg, Witthaus and Randall, representing the General Electric Company, have tested the candle power of the Buffalo City arc lamps, and reported that the maximum and minimum candle power of the three lamps tested were 2,459, 2,356, 2,314 and 2,097 1,986, 2,138 respectively. It is not stated what current was used or the method employed by which these extraordinary results were obtained.

An Idea.—An ingenious general information machine has been set up in a railway station of Melbourne, Australia. By pressing different electric buttons the following among other things will appear: A list of the best hotels in the city, a list of the plays at the theatres, with their play bills, a list of the omnibus routes and the cab fares to the various points of interest. The principle of the machine is capable of indefinite expansion, and doubtless it will soon be introduced in this country.

Purdue University, Lafayette, Ind., has issued its annual register for 1892-93, from which we learn that during the past year there were 677 students in all of the courses. The electrical building, of which a view is given, is very handsome externally, and the description shows it to be well arranged and equipped. We note that a large engineering building is in course of erection. The Electrical Engineering Department during the last year was conducted by Professors Fessenden and Waterman and Assistant Gardner.

Electricity and Sewage.—The sewage disposal apparatus at Brewsters, N. Y., comprises a 15-h. p. engine, a 20-h. p. boiler, a dynamo and two vats, one holding 1,000 gallons and the other 3,000 gallons. The vats are used for the electro-chemical treatment of the sewage. One receptacle serves for the mixing of the chemicals with the deposit, from which a pipe conveys the compound to the other, in which there is a combination of electrodes that agitates the mass and also conducts a current through the solution with the effect of deodorizing, disinfecting and vaporizing the offensive accumulation. The action in the vat is similar to a violently effervescing spring. The inventor, Mr. Woolf, is enthusiastic respecting his method of germ destruction and deodorization of foul substances.

Trolley Feed Wires.—The Philadelphia Traction Company's engineers have been busy on plans for conduits in which to lay the trolley feed wires for the 110 circuits which are to be supplied by the power-house at Ridge avenue and Mount Vernon street. The ends of these conduits will cover a space of 10 square feet, and the question is to dispose them so as to give a chance to repair the wires without interfering with the city's gas and water pipes or sewers. Director Windrim and Chief Walker, in consultation with Chiefs Bullock, Park and Ogden, decided that the best thing to do would be to ask the railway engineers to prepare plans which will practically make the space between the tracks of trolley lines immense vaults, in which the wires can be placed. As most of the city's structures are on either side of the car tracks the director thinks that this will be the cheapest and best way to dispose of the matter. Where gas and water pipes or sewers run along cross streets the conduits can be "spread out," part going over and part under the obstruction.

Trade and Industrial Notes.

George Cutter, Chicago, Ill., is importing a fine line of French carbons which are claimed to be superior to any on the American market.

J. Grant High, 123 N. Third street Philadelphia, Pa., has issued an illustrated price list, No. 1, of his single throw, single and double pole switch.

Messrs. A. Colondre & Co., engineers, Catania, Sicily, are agents for the well-known United States Wind Engine and Pump Company, of Batavia, Ill.

E. H. Cadiot & Cie., 44 Rue Taitbout, Paris, has placed on the market a small dynamo so mounted that it may be run by power or by hand, and intended primarily for the use of schools.

Edward P. Kinney, formerly of Butte, Mont., has located at 626 Hammond Building, Detroit, Mich., where he has opened his office as consulting and contracting electrical engineer, and although there only one month finds business very encouraging.

The Brooklyn Electric Manufacturing Company, 286-290 Graham street, Brooklyn, N. Y., reports large and increasing orders for the Baehr quick break switch. Street railway men generally are fast recognizing the efficiency of this switch, judging from orders.

The Ford-Washburn Storelectro Company, Cleveland, O., has reprinted the report of Professors Langley and Mabery, of the Case School of Science, on the Ford-Washburn storage cell. Those interested in storage batteries will find this lengthy and detailed report of value.

The Burgess Soldering Furnace Company, Columbus, O., which manufactures the Gem gasoline furnace for electricians use, is now able to fill orders promptly, having caught up with back orders. Tinners, plumbers and electricians find the "Gem" very valuable in their work.

The Huyett & Smith Manufacturing Company, Detroit, is shipping a large number of its ventilating fans and motors, and has just put in the City Hall Building, Brockton, Mass., one of its heating systems for 10,000 feet heating plant, 72 inch disc fan direct connecting electric motor.

The new machine shop of the Coe Brass Manufacturing Company will be 40 ft. wide and 300 ft. long, two stories high. The building is designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., and will be covered with its patent anti-condensation corrugated iron roofing.

The Thompson Smokeless Fire Company, 803 Hamilton Building, Pittsburgh, Pa., are introducing in America the Thompson system for the prevention of smoke, which has been so successfully used in Europe, and the inventor of which was awarded the gold medal of the London Society of Science, Letters and Arts.

J. H. Bunnell & Co., 76 Cortlandt street, New York, has issued a new edition of their catalogue, No 13, dated June 1893, which, however, retains the familiar appearance exteriorily of previous issues. Many new and interesting additions have been made, and we note that the convenient tables, so long a feature of this catalogue, have been retained.

The Columbus Electrical Machine Works, Columbus, O., who are successors to the Minott Electrical Machine Company, will continue the business of repairing armatures and commutators, and manufacturing motors, dynamos, etc. They will give special attention to repairing engines and machinery of every kind. They have issued a neat catalogue.

The American Electrical Works, Providence, R. I., sent us a Fourth of July fire cracker, which we only discovered to be an imitation on that glorious day from its failure to go off; upon examining the interior we first discovered to whom we were indebted for it—which accounts for this late acknowledgment. The patriotic sentiments in the interior, however, more than compensate for our disappointment.

The Purity Oil Filter Manufacturing Company, 90 Water street, Pittsburgh, Pa., has issued a new circular and price list. This company is sending its oil filters to all parts of the country and has received several letters from California speaking in great praise of its Ideal steam oil refiner, and, among others, a letter from A. L. Ide & Son, manufacturers of the Ide and Ideal engines, expressing the greatest satisfaction with its filters.

Cooper, Roberts & Co., Mt. Vernon, O., who manufacture first-class automatic engines, are busy filling orders. They have recently shipped a 100-h. p. high-speed engine for the electric plant in the Hartford Building, Chicago, Ill., and another 100-h. p. high-speed engine for the Electric Light Company, Garrettsville, O., and have several orders on hand. Their engine being very compact, and not occupying much space, is suitable for electric light plants.

The Detroit Dynamo Company, Detroit, Mich., have recently installed a plant in the Persian steam laundry, Detroit, consisting of a 200-light dynamo and equipments complete, and have just put in a very fine marble 5 × 3½ ft. switchboard with double pole polished brass switches for the Ideal Manufacturing Company, Detroit, where they now have one of their 250-light dynamos, and expect to soon put in another of same size. They are also fitting up a plant for Hugh Lyons & Co., Lansing, Mich., with dynamos, polishing lathes and plating machinery, etc.

The India Rubber Comb Company and the Goodyear Hard Rubber Company, 9 to 13 Mercer street, New York City, are the sole agents for the insulated wires and cables manufactured by the Chicago Electric Wire Company. They claim that this wire is very superior for electric light, telephone and telegraph, railway and underground and submarine services. Insulation resistance is claimed to be fully five times higher than any ever before attained and will stand double the amount of voltage and any amount of bending without deterioration.

The Dayton Globe Iron Works, of Dayton, O., has recently shipped to the city of Brainard a carload of machinery, consisting of a 66-inch turbine and gearing for that city's electric light plant. This company has also recently received an order from the Buchanan (Mich.) Electric Light and Power Company for three 48-inch special new American turbines with complete outfit of gearing, shafting, clutch couplings, etc.; also an order from the West Michigan Electric Company, of Grand Rapids, Mich., for two 48-inch turbines in horizontal iron flumes with complete outfit of shafting, boxes, etc.

Mr. Paul T. Kenny left on the Campania June 30 for a six-months pleasure trip through Europe, Asia and Africa. Several months ago Mr. Kenny severed his connection with the Mather Electrical Company and started in business as an electrical contractor, making a specialty of electrical transmission of power. As an evidence of his success he reports the following contracts for motors in Brooklyn alone during the past month; Blake Manufacturing Company, 20 h. p.; Hendron Manufacturing Company, 50 h. p; Pellissier, Jeunes & Rivert, 20 h. p.; estate of A. Froelich, 20 h. p.; D. W. Binn's Foundry, 15 h. p., and Gorty & Sons, 4 h. p.

Jenkins Brothers, 71 John street, New York City, have recently made marked improvements in their valves, having adopted a new form of holding the disc holder in place, having increased the number of bolts in the valve bonnets and having also increased the thickness of the flanges, so that the valves are suitable for high steam pressure. It is their intention to manufacture but one grade of valve, which will be suitable for any pressure. They have also made improvements in the manufacture of a rubber compound for use on high pressure steam apparatus, and for nearly two years have been using and testing this compound in the manufacture of Jenkins discs with very satisfactory results.

The Okonite Company, Limited, 13 Park Row, New York, have issued a new price list, No. 6, in which they have made an innovation in their former method of classification, by making three thicknesses of insulation, covering low-tension currents, or currents used for incandescent lighting, bell work, telephone and telegraph; medium tension currents, or currents more especially adapted for electric railways and telegraph; and high-tension currents, especially adapted for currents of high voltage. Besides these there are embraced line wires, tubing and tapes, both Okonite and Manson, the former being used especially where high insulation is a factor, and the latter or Manson tape for protection against abrasion and dampness. The pamphlet is neatly gotten up and printed, and has handsome covers.

Lindsay & Wilgus, 59 William street, New York City, have recently contracted for negotiating for all the equipment, material, etc., for the Carrollton (Mo.) Street Railway Company. This road is three miles in length, laid with 56-lb. rails, equipped with Baldwin 15-ton motors, and with passenger coaches similar to the ones in use on the New York & Brooklyn Bridge. The contract includes the building of the road complete, brick depot with metal roof and car shed. Lindsay & Wilgus have also contracted for all the material and the superintendence of the construction of the Portsmouth (O.) Railroad and Light Company plant. The contract for all grading, laying of ties and rails, etc., has been made by them and work has commenced. A 2,000-incandescent light station is to be operated in connection with this road. Lindsay & Wilgus have also negotiated for the equipment and construction for the Capitol City Railroad of Frankfort, Ky., which is five miles long, and in connection with its passenger service will have a large freight traffic in connection with the different distilleries in Frankfort.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.